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Love Canal Monitoring Program. GCA QA/QC (Quality Assurance/Quality Control) Summary Report

GCA Corp.
Bedford, MA

Prepared for

Environmental Monitoring Systems Lab.
Research Triangle Park, NC

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Project Officer

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Research Triangle Park, NC 27711

LOVE CANAL MONITORING PROGRAM
GCA QA/QC SUMMARY REPORT

Prepared by

GCA CORPORATION
GCA/TECHNOLOGY DIVISION
Bedford, Massachusetts

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16. ABSTRACT

One of the most important responsibilities of the Love Canal prime contractor was the institution and maintenance of a quality assurance program. An important objective of the quality assurance program was to alert the subcontractors to the importance of high quality work on their part and to demonstrate continuing concern for quality throughout the program. Measures taken to accomplish this included the provision of: general QA/QC requirements in the Requests for Proposal (RFP) for all technical work to be subcontracted; EPA's specific internal QC requirements in each analytical subcontract document; the requirement for subcontractor QA Plans; QC Coordinators with expertise in each technical area; written sampling and analysis procedures including QC requirements and planned corrective actions; Performance Evaluation and QC check samples for analytical work and, perhaps most important, continuing communication between GCA and its subcontractors.

This document describes the quality assurance effort by the prime contractor. Also included are examples of problems during the study and their resolutions.

17. KEY WORDS AND DOCUMENT ANALYSIS

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TABLE 2.1. TECHNICAL EVALUATION CRITERIA
(GCA 1-619-026-222-001)

Technical proposals received in response to the subject RFP will be evaluated using the following equally weighted criteria:

I. Offeror's immediate availability to initiate sampling, ability to respond on short notice with sufficient field personnel, and ability to complete the sample collection program by 31 October 1980.

II. Offeror's understanding of the scope and magnitude of the sampling effort required as demonstrated in the proposed technical approach.

III. Offeror's experience in sampling environmental pollutants in air, water, soils, sediment and biota.

IV. Offeror's proposed overall program management including qualifications of assigned personnel; i.e., experience, capability, and percentage of effort devoted to the program.

V. Offeror's experience in sampling organic pollutants by means of sorbent media.

VI. Offeror's ability to supply the required sampling equipment and spare parts.

VII. Offeror's Quality Assurance/Quality Control Plan.

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CONTENTS

Figures. iv
Tables iv

1. Introduction 1-1
    Health and Safety 1-3
    Sampling. 1-3
    Analysis. 1-3
    Geotechnical. 1-5
    Sample Bank 1-5
    Data Management 1-8
2. Subcontractor Selection. 2-1
    Sampling. 2-1
    Sample Analysis 2-4
3. Quality Assurance Program. 3-1
    QA/QC Program Objectives. 3-1
    Design of QA Program. 3-2
    QA Project Plan 3-2
    Requirements for Subcontractors' QA Plans 3-5
4. QA/QC Implementation 4-1
    Sample Collection and Handling. 4-2
    Geotechnical Study. 4-5
    Sample Analysis 4-6
    Data Management System. 4-31
    Corrective Action System. 4-33
    Document Control/Chain-of-Custody Procedures. 4-34

Appendices

A. Audit Reports. A-2
B. Sampling and Analytical Internal QC Checks B-1
C. Corrective Action Report Forms C-1
D. Miscellaneous Supporting Information D-1

FIGURES

Number | | Page
1.1 GCA project organization and responsibility. 1-2

TABLES

Number | | Page
2.1 Technical Evaluation Criteria. 2-2
2.2 Problem Compounds. 2-6
2.3 Prospective Bidders List 2-10
2.4 Technical Evaluation Criteria. 2-13
2.5 Analytical Program Configuration 2-16
3.1 Appendix B--Section Headings 3-6
3.2 Subcontractor QA Plan QA/QC Measures 3-9
4.1 Sampling QA/QC Measures. 4-3
4.2 Analytical QA/QC Measures. 4-7
4.3 Analytical Subcontractor Internal QC Requirements. 4-9
4.4 Performance Evaluation Samples Used for Love Canal Study 4-23
4.5 External QC Check Samples Used for Love Canal Study. 4-25
4.6 Data Management QA/QC Measures 4-32

SECTION 1

INTRODUCTION

The purpose of the Love Canal Monitoring Program was to evaluate pollutant levels present in the Love Canal Area of Niagara Falls, New York. EMSL/Las Vegas, EMSL/Research Triangle Park, EMSL/Cincinnati, Health Effects Research Laboratory (HERL)/Research Triangle Park, and the Robert S. Kerr Environmental Research Laboratory, Ada, Oklahoma, collaborated on the design of the study with EMSL/RTP assigned as the coordinating EPA laboratory. Events surrounding the Love Canal situation during the early summer of 1980 made the timely completion of the entire monitoring program of highest importance within the Agency. Accordingly, GCA/Technology Division was issued a task on July 9, 1980 to assist EPA in successfully completing the Love Canal Monitoring Program within a very restrictive time frame. GCA was charged with the responsibility of managing the program and ensuring its timely completion in a technically acceptable manner through the use of selected subcontractors. Each of the EPA laboratories was to maintain a high level of involvement throughout the program, providing technical advice, undertaking quality control activities, and determining the validity of the data generated.

The program involved a multifaceted sampling and analytical effort designed to detect and quantify a variety of trace metals,* volatile organics, pesticides and other compounds in soil, sediment, air, biota, and water samples. The principal purpose of these activities was to provide data with which EPA could assess the extent of environmental contamination in the Love Canal Area. Since the area declared as a National Emergency was extended from those homes directly surrounding the Love Canal dump site to a more general area on May 21, 1980, it had been determined that the overall exposure of residents must be established as quickly as possible. The program, therefore, was on an extremely tight schedule with field sampling activities to be completed by October 31, 1980.

GCA organized its efforts into seven technical elements as shown in Figure 1.1, Project Organization Chart. Although the various EPA laboratories had designed the overall study and provided detailed protocols for many of the program elements, it was GCA's responsibility to coordinate and implement these procedures into a manageable system. The following paragraphs very briefly describe the activities undertaken by GCA in each of the seven program elements.

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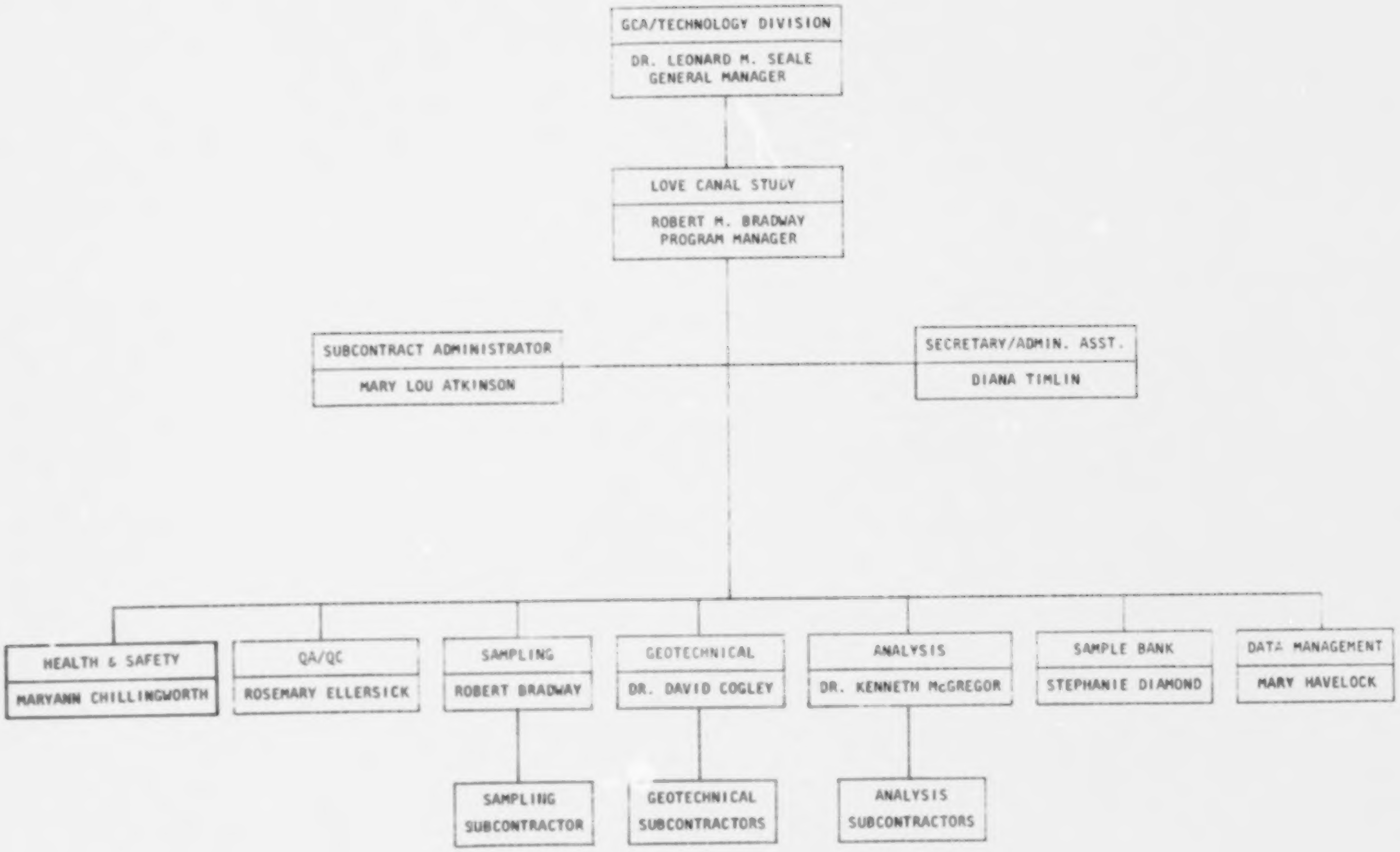
*Refer to Appendix D (pp. D-2) for compound hit lists and explanation of terms used for compound classes.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GEOTECHNICAL SUBCONTRACTORS
ANALYSIS SUBCONTRACTORS

Figure 1.1. GCA project organization and responsibility.

HEALTH AND SAFETY

A comprehensive safety and health plan was developed which specified procedures to help protect all personnel engaged in the Love Canal Monitoring Project. The complexity and variety of chemical agents thought to be present at the Love Canal made it necessary to design a highly flexible yet conservative program of worker protection. The advice of consultants was sought in the design of this program, and safety and health guidelines provided by the Federal Government and the State of New York were incorporated.

The basic elements of the safety and health program consisted of a preassignment medical examination of each employee who was engaged in sampling in the field or in the handling of samples in the field prior to their shipment to subcontractor laboratories. The medical examinations and subsequent consulting services were provided by physicians who are Board-certified in industrial medicine.

Individuals involved in field sampling activities were trained in the use of safety and protective gear appropriate to the activity. GCA provided two industrial hygienists, and the sampling subcontractor, Geomet Technologies, Inc., also provided two industrial hygienists to review and monitor procedures and sampling activities at the Love Canal site. The Geomet industrial hygienists were on site during any sampling activities. A series of Safety and Health Directives were issued to address procedures to be followed during the several sampling activities. Review of laboratory safety procedures in force in the subcontractors' laboratories was made to ensure that the levels of protection provided were consistent with the hazards potentially present in the samples they analyzed.

SAMPLING

The overall program design and the specific sampling protocols had been developed by EPA. It was GCA's responsibility to acquire via competitive bids a qualified subcontractor to collect the multimedia samples for subsequent analysis for volatile organics, semivolatile organics, pesticides, inorganics and radioactivity.

Air samples were collected in the living areas of homes, in basements and outdoors using Tenax, polyurethane foam (PUF) and hi-vols. Water samples were collected from drinking water supplies, sewers, basement sumps, rivers, streams and ground water monitoring wells. Soil and sediment samples were collected throughout the study area. A biota sampling campaign also resulted in the collection of animals and plant materials.

ANALYSIS

As with sample collection, the analytical protocols were provided by EPA. GCA had to procure via competitive bids the appropriate number of subcontractor laboratories to provide the analysis of the collected samples. In addition subcontractor laboratory services were procured for the preparation of the Tenax and PUF cartridges and the preparation of Tenax cartridge standards and spikes. The HERL/RTP prepared the QC standards and spikes for the PUF cartridges.

The analysis of the Tenax cartridges was accomplished by thermal desorption, cryogenic trapping and capillary column gas chromatography/mass spectrometry (GC/MS). The polyurethane foam plugs were extracted with 5 percent ether in hexane and, following column chromatographic cleanup, analyzed by electron capture-gas chromatography (EC-GC). Analytical confirmation was by GC/MS. The hi-vol filters were analyzed for metals by inductively coupled plasma (ICP) by EMSL/RTP.

Water samples were analyzed by Methods 624, 625 and 608 for volatile organics, semivolatile organics and pesticides, respectively. Analysis for metals was by ICP or Atomic Absorption Spectroscopy (AAS) except that AAS was required for mercury and selenium. In addition, ground water samples were analyzed for Total Organic Carbon (TOC) and Total Organic Halides (TOX).

The soil and sediment samples were analyzed for volatile organics with a modification of Method 624 for purgeables. In this analysis, a soil or sediment sample was placed in the purge chamber, a prescribed amount of organic-free water was added, and the sample purged for 12 minutes. The sample was then analyzed by the standard purge and trap GC/MS system used in Method 624.

The analysis of soils and sediments for semivolatiles was not so straight forward in that a methods evaluation needed to be conducted on 48 samples to determine which of three available procedures would produce the best results. The data from these first 48 samples were evaluated by EPA and discussed with GCA in order to determine the most suitable protocol to be used for the remainder of the program. The selected method consisted of extraction using an homogenization apparatus. Samples were extracted with pH11 and then pH2 methylene chloride to obtain the base/neutral and acid extractables, respectively. After concentration of the extracts, an aliquot of each was taken to form a combined extract. The combined fraction was then analyzed by capillary column GC/MS.

Pesticide analysis of soils and sediments required sample preparation methods specific to each medium. For soils, a soxhlet extraction with acetone-hexane was followed by extract concentration and successive cleanup by aluminum oxide and Florisil columns. The sediment extraction procedure used column elution with 1:1 acetone:hexane, washing with water, and extraction of the pesticides from the water by methylene chloride in hexane. In both cases, the analysis of the extracted pesticides was accomplished using Method 608 (EC-GC). The priority pollutant metals in soils and sediments were determined by AAS after an acid digestion.

Various biota samples were analyzed for organic and inorganic species on the Love Canal Monitoring List.* Biological materials, specifically mice, worms, and crayfish were analyzed for semivolatile organics and pesticides using both GC/Hall and GC/MS after appropriate digestion and extraction procedures. Potatoes and oatmeal placed at the sampling sites were designated as "foodstuffs" and analyzed for volatile organic compounds. The analytical method consisting of enclosing the sample with an acid solution in a septum vial, digesting the sample to generate a headspace sample within the vial, and analyzing the headspace for the hitlist compounds by GC/Hall. Metals were measured in vegetation by ICP and AAS after acid digestion and in hair by AAS, also after acid digestion.

GEOTECHNICAL

The geotechnical portion of the Love Canal Study was designed principally by the EPA's Robert S. Kerr Laboratory in Ada, Oklahoma. It consisted of the following three activities:

- Geophysical measurements such as ground penetrating radar, electromagnetic conductivity and magnetometry to determine subsurface characteristics.
- Hydrogeological investigation which consisted of the installation of 174 monitoring wells.
- Ground water modeling which predicted the movement in each aquifer.

GCA's responsibility was to obtain the necessary subcontractor skills via competitive bids and to ensure the timely completion of the work. There were Ada staff on site to provide technical advice during the field program.

SAMPLE BANK

The sample bank was set up and staffed with GCA personnel during the field program. The purpose of the sample bank was to oversee all aspects of sample handling, chain of custody procedures and document control. The Sample Bank Manager served as GCA's Document Control officer onsite and directed the following activities:

- dispensing custody records
- receiving precleaned air collection media
- receiving external QC samples and calibration standards
- dispensing sample tags
- receiving collected samples

---

*Refer to Appendix D (pp. D-2) for compound hit lists and explanation of terms used for compound classes.

- verifying custody record against collected sample before accepting custody
- logging accepted samples into Master Log
- maintaining internal custody of samples while in the Sample Bank
- maintaining document control of sample tags and custody records
- regrouping collected samples for shipment to analytical labs
- inserting external QC samples into the analytical shipments
- packing samples appropriately for shipment
- transferring custody of the sample shipment to the carrier
- notifying the analytical laboratory of shipment

The selected Sample Bank facilities were appropriate for this multifaceted operation; they included a 400 square foot shipping and receiving area, 1,240 square feet of fully equipped laboratory space, and 230 square feet of office space at the Bell Aerospace Textron plant in Niagara Falls, New York. A 35-foot refrigerated trailer was placed adjacent to the entrance to provide 245 square feet of refrigerated storage area at the Bank; a refrigerated truck was also leased to transport samples from their collection area to the Bank and from the Bank to Buffalo Airport for shipment to analytical laboratories.

The laboratory area included two 6-foot fume hoods, sinks, refrigerators, a freezer, and adequate bench space. The air handling system was modified to ensure 100 percent fresh air intake and no air return through the system to avoid contamination of collected samples. The office area included standard office furnishings and a copying machine.

The entire area, including the refrigerated trailer, had access restricted to GCA employees with keys; it was accessible 24 hours a day, 7 days a week. Bell Aerospace security guards maintained security of the whole complex at all times. The file cabinets and storage containers for documents and samples were equipped with security bars and combination locks.

Sample Receipt/Acceptance

The Sample Bank staff checked each sample against its identification tag and custody record before accepting custody of the sample. The condition of each sample was noted and recorded in the appropriate Master Log. Due to the complexity of the program, separate logs were maintained for:

- precleaned collection media
- QC samples
- collected air samples
- collected water samples
- collected soil and sediment samples, including well cores
- collected biota and other samples

The Sample Bank Log entry also included the collection tag number, custody record numbers, analysis tag number, and ID number of the analytical lab to which the sample was sent. This log provided input to, and backup for, the computer file cross-referencing all sample numbers.

Chain of Custody

The purpose of chain of custody procedures was to document the identity of the sample, and its handling, from its first existence as a sample until its ultimate disposal. The procedures used on this program were developed by GCA from NEIC guidelines and reviewed by NEIC staff members. Customized sample tags and custody records traced a sample from its collection through all transfers of custody until it was transferred to an analytical laboratory. Internal laboratory records then documented the custody of the sample.

In order to establish that a sample was valid, it was also necessary to document that no tampering had occurred--either to the sample itself, the sampling equipment used, or the environment sampled. This was done by the use of evidence tape, locks and custody seals, and documented entries noting their condition in field and laboratory log books. The custody record also documented any tampering that occurred; the absence of any such comments indicated no tampering during the period of custody.

The GCA Sample Bank provided and dispensed evidence tape, sample tags, custody records, logbooks, field and laboratory data sheets, custody seals and locks as appropriate. Instructions for use of these materials were provided by the Sample Bank Manager and the GCA sampling QC coordinator in the Love Canal area.

Document Control

The purpose of document control was to ensure that all project documents were identified and accounted for.

A project code was used for identification; the code for the Love Canal Study is LC 1-619-026. This number appeared on sample identification tags, custody records, logbooks, data sheets, project memos and reports, document control logs, corrective action forms and logs, QA Plans, and all other project records. In addition, sample tags and custody records were serially numbered before distribution. Each serial number was accounted for so it can be demonstrated that no collected sample was lost or removed from its normal progression through the system.

DATA MANAGEMENT

The purpose of the data management system was to collect and store all data generated as part of the Love Canal Monitoring Program and to provide basic reports of the monitoring results. Development of a system to manage and report the sampling data required activity in four general areas:

- Defining data flow and traceability
- Preparation of data coding forms
- Creation of a manual of codes and data coding procedures
- Development of handling and reporting software

The system developed consisted of these separate data files:

- Raw data--This data file represented data which had received a cursory review to confirm that the data had been provided in the proper format. Coding manuals supplied to the subcontractors identified the mandatory information for each type of sample and analysis. The review checked that this mandatory data was supplied and corrected any errors shown by visual or computer check.
- Verified data--At the verified data level, the GCA computer printout had been reviewed by the supplying group (e.g., the analytical laboratories) for agreement with their original data and any errors in transcription, keying, or processing corrected by GCA.
- Validated data--The validated data file corresponds to a much higher level of review. All QC runs, both internal and external, were reviewed by EPA in relation to the analytical concentrations. EPA then instructed GCA as to which data in the verified file had to be deleted in order to generate the validated file.

QA/QC

The remainder of this report discusses the Love Canal Monitoring Program QA/QC functions and the specific actions taken by GCA to implement the QA/QC Plan.

SECTION 2

SUBCONTRACTOR SELECTION

The principal responsibility of GCA/Technology Division in the Love Canal Monitoring Program was to implement the EPA designed study by procuring subcontractors and managing their efforts. This section describes the subcontractor selection process for the sampling and analysis study areas.

SAMPLING

GCA's first task was to take the various sampling protocols provided by the various EPA laboratories and combine them into one, consistent Bid Package. The number of samples to be collected using each protocol was stipulated as well as the schedule so that comparable bids would be received.

The bid package also included Special Instructions, Technical Evaluation Criteria, General Instructions, Representations, Certifications and Acknowledgments, Certificate of Current Pricing Data and Delivery Requirements. Of particular relevance here is the list of Technical Evaluation Criteria that was contained in the RFP and is listed in Table 2.1.

The various EPA laboratories had supplied GCA with the names of firms that were thought to have the capability of undertaking the sampling task. Since time did not permit the formal announcement of the solicitation, the list of 10 firms supplied by EPA was used as the prospective bidder's list. Each of the firms was contacted by telephone on 14 July 1980 to be invited to the 17 July Bidder's Conference in Buffalo, New York. Confirmations of these invitations were issued by TELEX on 16 July 1980.

The firms invited to the bidder's conference included the following:

1. Battelle Memorial Institute
   505 Kings Avenue
   Columbus, OH 43201

2. Research Triangle Institute (RTI)
   Post Office Box 12194
   Research Triangle Park, NC 27709

TABLE 2.1. TECHNICAL EVALUATION CRITERIA (GCA 1-619-026-222-001)

Technical proposals received in response to the subject RFP will be evaluated using the following equally weighted criteria:

I. Offeror's immediate availability to initiate sampling, ability to respond on short notice with sufficient field personnel, and ability to complete the sample collection program by 31 October 1980.

II. Offeror's understanding of the scope and magnitude of the sampling effort required as demonstrated in the proposed technical approach.

III. Offeror's experience in sampling environmental pollutants in air, water, soils, sediment and biota.

IV. Offeror's proposed overall program management including qualifications of assigned personnel; i.e., experience, capability, and percentage of effort devoted to the program.

V. Offeror's experience in sampling organic pollutants by means of sorbent media.

VI. Offeror's ability to supply the required sampling equipment and spare parts.

VII. Offeror's Quality Assurance/Quality Control Plan.

3. Radian Corporation
Post Office Box 9948
Austin, TX 78766

4. PEDCo Environmental, Inc.
11499 Chester Road
Cincinnati, OH 45246

5. IIT Research Institute
10 West 35th Street
Chicago, IL 60616

6. Geomet
15 Firstfield Road
Gaithersburg, MD 20760

7. Southwest Research Institute
Post Office Box 28510
San Antonio, TX 78284

8. Midwest Research Institute
452 Volker Blvd.
Kansas City, MO 64110

9. Gulf South Research Institute
Post Office Box 1177
New Iberia, LA 70560

10. Environmental Science & Engineering
Post Office Box ESE
Gainesville, FL 32604

Of the ten organizations invited to the bidder's conference, eight were actually in attendance. The eight include the following:

1. Battelle Columbus Laboratories
2. IIT Research Institute
3. Gulf South Research Institute
4. Geomet
5. Southwest Research Institute
6. Radian Corporation
7. PEDCo Environmental, Inc.
8. Environmental Science & Engineering

At the bidder's conference the RFP package was distributed to all in attendance. All aspects of the cost and technical requirements were discussed in detail by GCA personnel with questions from the attendees encouraged as each aspect of the program was discussed. Any remaining questions that had not been dealt with during the previous discussions were answered so that each of the prospective bidders had an equal understanding of the program requirements. The due date for proposals was 21 July 1980 at 5:00 p.m. EDT. The entire bidder's conference was transcribed by a Notary Public and typed copies of the proceedings were available to GCA at the end of the day for documentation.

Five firms responded with proposals in response to the RFP. These included:

1. Battelle Columbus Laboratories
2. IIT Research Institute
3. Geomet
4. PEDCo Environmental, Inc.
5. Environmental Science & Engineering

Based on the technical evaluation of these five proposals, two firms were invited to GCA for best and final discussions. This process led to the selection of Geomet Technologies, Inc. as the sampling subcontractor.

SAMPLE ANALYSIS

Understanding Program Requirements and Bid Package Preparation

The initial work performed by GCA involved the familiarization of GCA staff with the methodology requirements and the stage of development of the program. This activity entailed a series of meetings with the various EPA groups during the period of 9 July to 19 July 1980. It became clear very early on that the methods were, with some exceptions, very near implementation and that GCA's role was to execute the program using the analytical methods specified by EPA and to obtain data consistent with the capabilities of the methods. Our objective then was to document the analytical methods and EPA-required quality control measures in sufficient detail that bid packages and, subsequently, analytical procedures manuals could be prepared.

In order to prepare the bid packages, GCA staff consulted with the responsible EPA personnel or their designees for each media to be addressed. Brief summaries of the results of these consultations and specific problem areas are given below for each media.

Air--

EMSL/RTP had responsibility for the volatile organics and trace metals and HERL/RTP had responsibility for semivolatile organics in air. Because EMSL/RTP elected to perform the trace metal analyses in-house, no subcontractors were solicited for these analyses. For the organic species, each EPA lab provided a list of targeted compounds (see Appendix D, Tables D-1 and D-2) and protocols for the analyses outlining both the methodology to be used and the quality assurance requirements. GCA developed, in conjunction with the EPA* labs, the instrument performance specifications and the type and amount of quality control necessary to meet the QA requirements. These performance specifications and QC requirements were incorporated into the appropriate analytical protocols; the number of QA samples to be analyzed was added to the field sample totals to obtain the number of samples requiring analysis. The volatile organic analyses was designated as Task I and the semivolatile requirements as Task II of the bid package.

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*For the volatile compounds collected on Tenax, the staff of RTI was also consulted (vida post).

Crucial to this issue of organics in air analysis, was the provision of the specified collection media. Because the sampling effort was to commence immediately, in order to meet the time constraints of the program, the solicitation of competitive bids for this portion of the program was precluded. This fact was fully recognized by both EPA labs involved. Therefore, GCA solicited, in each collection media, bids from organizations recommended* by the EPA labs and proceeded to let sole source subcontracts to these organizations for the preparation of the collection media. PEDCo Environmental was subcontracted to perform preliminary cleanup on the Tenax resin and to prepare sampling cartridges. SWRI was subcontracted to perform cleanup on the PUFs

The procurement of the collection media differed for volatiles and semivolatiles. Because HERL/RTP had a sufficient quantity of PUF plugs, for the collection of semivolatile organics, no external procurement need existed; this media was simply supplied to the selected subcontractor. For the volatile organics, GCA elected to procure a sufficient quantity of Tenax and to provide the required amount to the selected subcontractor.

Water--

A hit list of compounds was developed by the responsible EPA laboratories. This list included the "priority pollutant" compounds and several nonpriority pollutant species that were suspected to be present in the area. (See Table D-3 in Appendix D.) The Federal Register (FR) methods (Methods 624, 625, 608) were specified as the analytical protocols for organic compounds and the ICP option for the metals.

Prior to commencement of the program, it was recognized by EPA that all compounds on the hit list were not amenable to analysis by the specified FR procedures. To address these problems, EPA provided a statement of the problems and recommended solutions as footnotes to the compound hit list. The problems that needed resolution are listed in Table 2.2. For items 1 and 6 (acrolein and acrylonitrile and benzidine), the alternate analytical methods would be used for quantitation if Method 624 or Method 625, respectively, detected their presence. Items 2 and 3 (N-nitrosodimethylamine and

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*The recommendations made by EPA were, in the opinions of the responsible GCA staff, clearly as qualified as any laboratories that could have been solicited for the media preparation tasks.

TABLE 2.2. PROBLEM COMPOUNDS

---

1. Acrolein and Acrylonitrile

These compounds may be observed to about 1 milligram per liter with Method 624. If detected the quantitative analysis must be accomplished by purging a second aliquot of the sample at 85°C as described in Method 603.

2. N-nitrosodimethylamine

This compound is not resolved from the solvent with the standard columns required for Method 625. It may be resolved with a 30 meter fused silica SE 54 capillary column.

3. Hexachlorocyclopentadiene

This compound decomposes in the injection port at the temperature required for Method 625. A second injection at a low injection port temperature is required to observe this compound when using the standard Method 625 columns. However, this compound is sufficiently stable for analysis with the 30 meter fused silica SE 54 capillary column.

4. 1,2-diphenylhydrazine

This compound decomposes in the GC injection port to azobenzene, and cannot be distinguished from it by 70 ev mass spectrometry. If observed it must be reported as 1,2-diphenylhydrazine or azobenzene.

5. N-nitrosodiphenyamine

This compound decomposes in the GC injection port to diphenylamine, and cannot be distinguished from it by 70 ev mass spectrometry. If observed it must be reported as N-nitrosodiphenylamine or diphenylamine.

6. Benzidine

This compound is decomposed during the solvent concentration and drying steps of Method 625. It may be observed, but the concentration measurement cannot be considered reliable. It must be confirmed using an alternative method such as Method 605 (Federal Register, December 3, 1979).

7. Alpha-, Beta-, Gamma-, and Delta-BHC, Endosulfan I&II, and Endrin

These compounds are sensitive to the pH=12 extraction conditions of Method 625 and are not observed under normal conditions. These compounds must be measured using Method 608 with confirmation by GC/MS using the Method 608 extracts.

hexachlocyclopentadiene) would be resolved by the use of fused silica capillary column methodology. For items 4 and 5 (1,2-diphenylhydrazine and N-nitrosodiphenylamine), the indicated reporting procedure would be used. Because all samples were being analyzed by Method 608 for pesticides and PCB's, the 608 extracts would be available for GC/MS analysis. This additional specification was added to the protocols; i.e., if Method 608 compounds were observed, at concentration levels observable by GC/MS, then GC/MS confirmation of their presence was required.

In order to detect compounds of potential interest that were not included on the list, the requirement to identify for each sample, up to 20 additional compounds present at relative concentrations above a specified level, was added to the protocols. Finally, for reasons of cost-effectiveness, it was desired to perform the GC/MS analysis of Method 625 compounds by combining the acid and base/neutral extracts into a single sample; also, for compounds that partition into both the acid and base/neutral extracts, higher quality data would result when extracts were combined. Because existing data indicated that the fused silica capillary column methodology was capable of the resolution required, the combination procedure was added to the protocols as an option. This option would be exercised only after additional data were collected and deemed satisfactory. The additional data would be generated by each subcontractor analyzing the first 15 samples using both combined and individual extracts.

It was GCA's responsibility to incorporate the modifications and additional specifications required to meet the program needs and provide written procedures. As for the air media, the quality control measures necessary to monitor control limits and to characterize the quality of the resulting data were determined in conjunction with EPA and these requirements were added to the bid packages.

In addition, GCA assumed the responsibility of procuring certain materials to be supplied to the subcontractors; the materials supplied to the subcontractors will be discussed in more detail in the following sections.

Soils and Sediments

EMSL/LV was the EPA laboratory responsible for the soil and sediment analytical protocols. The list of compounds targeted for analysis was the same as the water list. The methods selected for these analyses were basically modifications of the 624, 625 and 608 methods for organics. Standard preparation procedures with an atomic absorption analytical finish were selected for the metal analyses.

It was recognized by EPA, at the outset of the program, that specifying procedures adequate for the preparation of soil and sediment samples for organic analysis was problematic because no standard, or even widely accepted, protocols existed. For this reason, EPA requested that a method study be conducted as part of the program. In order to conduct this study, EPA provided three procedures to be evaluated. These procedures would be evaluated by analyzing the first 50 samples (40 soils and 10 sediments) by all three procedures. The data generated from this study would be provided to EPA in order to assist in selecting the method most appropriate to analyze the remainder of the samples. GCA documented these requirements and incorporated the study into the bid package as a separate task (designated as Task IV). The methods study was made a separate task principally to facilitate the bidding process and to allow evaluation of proposals in terms of the methods study experience of the individual offerors.

The analytical work required for the remainder of the organic analysis soil and sediment samples was designated as Task V in the bid packages. Offerors interested in bidding Task V were required to provide individual bids for each of the three procedures. As for the other tasks, the internal quality control requirements were specified and the external quality control and quality assurance samples were added to the sample totals for bidding purposes.

As mentioned above, GCA assumed responsibility for providing to the selected subcontractors certain materials required to complete the program. These included:

- Fused Silica Capillary Columns
- Analytical Standards
- Internal Standards
- Surrogate Compounds
- Quality Control Samples

The specifications for and source of these materials were provided by the responsible EPA laboratories. GCA procured a sufficient number of narrow bore fused silica capillary columns (from the same production run) to provide each subcontractor with at least one column. GCA procured the internal standards and surrogate compounds and provided them to EMSL/LV for disbursement. Quality control samples (sealed ampules of concentrates) were provided to GCA by EMSL/CI for disbursement to the subcontractors. At the request of GCA, EMSL/LV (via the EPA standards repository) provided the analytical standards to the subcontractors.

As for the water samples, the option of analyzing the sample extracts by combining certain extracts was included in the bid packages. This led to several configurations to be bid upon because extract combinations, if any, would depend on the preparatory method selected. The extract combination decision was not made part of the methods study but was deferred until an extraction procedure was selected. If extract combination remained an option after determining the extraction procedure, then combined and uncombined extracts would be analyzed on a sufficient number of samples to make the decision.

Biota--

EMSL/LV had responsibility for the biota program. At the time the bid packages were being prepared, the design of the biota program was not specified. However, analytical procedures for semivolatile organics in specific biota were provided that were sufficient to obtain competitive bids. Therefore, the procedures were incorporated into the bid package along with the QC and QA requirements. The analytical effort for biota was designated Task VI.

Bidders Conference

Because of the stringent time frame of the program, a formal CBD announcement of the subcontracting requirements could not be made. Therefore, GCA contacted a number of organizations potentially qualified to perform the analytical work and invited them to a bidders conference. We began with lists of potentially qualified companies provided by the EPA laboratories and supplemented these lists with other companies which we felt qualified. In addition, all organizations who gained knowledge, by whatever means, of the upcoming bidders conference were invited to participate. Table 2.3 lists these prospective bidders. GCA felt that a bidders conference was mandatory because of the time constraints which essentially precluded any extensions in bid response time for scope of work clarifications.

A bidders conference was held on July 22, 1980. The conference was attended by representatives from 19 organizations as indicated in Table 2.3. Each organization was provided a copy of the RFP which included, for each task, a scope of work, a statement of the deliverables, and the procedures to be used. The scope of work was addressed in some detail verbally with reference to specific procedures and other points in order to introduce the program requirements to the potential offerors in enough detail to provoke specific questions.

The minutes of the conference were recorded by a qualified court recorder.

Proposal Evaluation

Proposals were received from 19 organizations as indicated in Table 2.3. One proposal was not accepted because it was received late (the following day). All proposals were received by GCA Contracts Administration where the technical and cost proposals were separated. After receiving all proposals, the technical portions were provided to the technical staff for review.

The technical proposal review was conducted in three phases. Each phase of review focused on one or more of the proposal review criteria set forth in the RFP package. These criteria are listed in Table 2.4. First, the proposals were reviewed in terms of their responsiveness, in general, to all criteria. This overall evaluation emphasized quality assurance management and experience in the analysis of environmental samples. All bidders that (1) failed to provide a description of their QA/QC program, (2) did not have

TABLE 2.3. PROSPECTIVE BIDDERS LIST

Company	Attended bidders conference	Submitted proposal/bid
Acurex Corp. 485 Clyde Avenue Mountain View, CA 94042	Yes	Yes
Battelle Memorial Institute 505 Kings Avenue Columbus, OH 43201	Yes	Yes
California Analytical Labs 401 N. 161th Street Sacramento, CA 95814	Yes	Yes
Environmental Science & Engineering P.O. Box ESE Gainesville, FL 32604	Yes	Yes
Geomet 15 Firstfield Road Gaithersburg, MD 20760	Yes	No
Gulf South Research Institute P.O. Box 1177 New Iberia, LA 70560	Yes	Yes
IIT Research Institute 10 West 35th Street Chicago, IL 60616	Yes	Yes
Jacobs Engineering (PJB) 251 S. Lake Avenue Pasadena, CA 91101	Yes	Yes
Midwest Research Institute 452 Volker Blvd. Kansas City, MO 64110	Yes	Yes
Radian Corporation P.O. Box 9948 Austin, TX 78766	Yes	Yes

(continued)

TABLE 2.3 (continued)

Company	Attended bidders conference	Submitted proposal/bid
PEDCO Environmental 11499 Chester Road Cincinnati, OH 45246	Yes	Yes
Systems Science Software P.O. Box 1620 LaJolla, CA 92038	Yes	No
Southwest Research Institute P.O. Box 28510 5220 Culebra Road San Antonio, TX 78284	Yes	Yes
TRW 3 New England Executive Park Burlington, MA 01803	Yes	Yes
University Hygienic Lab University of Iowa Oakvale Campus Iowa City, Iowa 52242	No	No
Monsanto Research Station B, Box 8 Dayton, OH 45407	Yes	No
OH Materials P.O. 1022 Findlay, OH 45840	Yes	Yes
Science Applications, Inc. 464 Prospect Street P.O. Box 2351 LaJolla, CA 92038	Yes	Yes
ERCO 185 Alewife Brook Parkway Cambridge, MA 02183	Yes	Yes

(continued)

TABLE 2.3 (continued)

Company	Attended bidders conference	Submitted proposal/bid
Measurement Sciences Corp. 300 Garden City Plaza Garden City, NY 11530	Yes	Yes
Compuchem A Division of Mead Corporation 5 Triangle Drive Research Triangle Park, NC 27709	No	Yes
Kemron Environmental Services 32740 Northwestern Highway Farmington Hills, Michigan 48018	No	Yes
Advanced Environmental Systems, Inc. Monitoring and Support Laboratory P.O. Box 165 Niagara Falls, NY 14304	No	Yes

TABLE 2.4. TECHNICAL EVALUATION CRITERIA

Responses to the subject RFP will be evaluated using the following equally weighted criteria:

I. Offeror's immediate availability to initiate analysis, ability to respond on short notice with sufficient analytical personnel, and ability to complete the sample analysis program by 30 November 1980. The demonstrated analysis throughput of each laboratory will be one measure of these abilities.

II. Offeror's Quality Assurance/Quality Control Plan.

III. Offeror's experience in analyzing environmental pollutants in air, water, soils, sediment and biota, as appropriate to your bid.

IV. Offeror's availability of appropriate instrumentation and other facilities required to complete the program.

V. Offeror's proposed overall program management including qualifications of assigned personnel; i.e., experience, capability, and percentage of effort devoted to the program.

experience in the analysis of environmental samples and (3) did not delineate their management approach were eliminated. This phase resulted in the elimination of three offerors.

The second phase of the review dealt with determining the specific qualifications of the offeror versus the individual tasks they bid. In order to be considered further as a candidate for a specific task, the offeror must have had experience with the specified method, have the necessary facilities and equipment (except those to be provided by GCA), and have the qualified personnel required. This phase of the review resulted in a listing of potential subcontractors grouped according to "task qualified for."

In the third phase, the capacities and the preferences (statements of preference were solicited) of the qualified offerors were considered. Some offerors were qualified for more than one task but stated a preference of a particular task and/or stated the impact on their ability to perform a task if awarded certain other tasks. Finally, while some offerors were qualified to perform certain tasks, the quantity of analyses bid was very small compared to the total program needs. These offerors were not eliminated from consideration; however, they would not be considered as prime candidates unless necessary to meet the program requirements. The data from this phase were used to contruct matrices of possible award configurations.

Next, the cost proposal data were added to the configuration matrices developed from the technical review. At this point an analytical program configuration that was believed to be in the best interest of GCA and EPA was constructed. It should be noted that in the recommended configuration, the offers would not receive as many samples as their stated capacity but rather, in most cases, about 50 percent of the stated capacity.

Recommendations to EPA and Contract Awards

GCA staff presented the recommended configuration to EPA on August 6, 1980. The presentation was made in a series of meetings at RTP and by conference call. Representatives from EMSL/RTP and HERL/RTP (air media), ERL/Ada, Oklahoma (ground water), and EMSL/CI (water QA) attended the meetings.

In addition to the data used to construct recommended configuration, all information resulting from the evaluation was made available to the responsible EPA staff. One offeror in the air analysis area was questioned by EPA. EPA staff indicated a problem with this offeror's lab that surfaced during previous work at Love Canal. The problem was clearly defined and involved the offeror's failure to adequately prepare the sampling media. Because this offeror would not be preparing the sampling media and because he was qualified to perform the analytical task, it was agreed that his selection would not be detrimental to the program.

Subsequent to these meetings, a presentation of GCA recommendations was made to EMSL/LV, via a conference call, regarding their program responsibilities. Similar information was provided to EMSL/LV. Again one offeror was questioned as to his ability to deliver on schedule. GCA explained that this offeror had been explicit and emphatic in his proposal regarding the issue of capacity. Nevertheless, EPA directed GCA to visit this offeror's facility and if, as a result of the visit, GCA remained convinced of his ability to deliver on schedule, then the offeror would be acceptable. The visit was conducted and it was concluded that the offeror was definitely capable of performing on schedule.

The meetings resulted in approval of GCA recommendations. The subcontracts were then negotiated and prepared for EPA Contracts' approval and bilateral execution. At this point the analytical program was configured as shown in Table 2.5. The subcontract with MRI was not finalized until later in the program; i.e., after final selection of the biota media and the analytical methods to be used. Also, SWRI's subcontract was subsequently modified to include a portion of the biota analyses (trace metals in biota and volatile organics in foodstuffs) and Task VII.

After some problems emerged with one of the subcontractors (vida post), a subcontract was negotiated with TRW, Inc. of Redondo Beach, CA for the analysis of water samples. In addition, several sole source subcontracts were let based on EPA recommendations and additional program requirements. Research Triangle Institute (RTI) was subcontracted to prepare spiked standard and QC Tenax cartridges for use in the air monitoring program. As an additional check on the Tenax QA/QC, IIT Research Institute (IITRI) was subcontracted to analyze a number of the standard and spiked Tenax cartridges using independent calibration. Advanced Environmental Systems (AES) was subcontracted to perform TOC, TOX, pH, and conductivity measurements on groundwater samples prior to their shipment from the Sample Bank so that highly dangerous samples could be appropriately handled. AES was chosen, in part, because of their location in Niagara Falls, NY. The final analytical subcontractor, Wright State University (WSU) was chosen to perform dioxin analyses in all media. WSU was recommended by HERL/RTP, which directed the dioxin study, because they were known to be experienced in the analysis of dioxin-containing samples, had a high resolution mass spectrometer for use in this program, and demonstrated a safety program adequate for the handling of dioxins. This brought the total number of subcontractors to 14 organizations involved in the analytical portion of the program.

TABLE 2.5. ANALYTICAL PROGRAM CONFIGURATION

Subcontractor	I	II	III	IV	V	VI	VII
Acurex Corp.			X	X	X		
Battelle	X						
CompuChem			X		X		
ERCO							X
GSRI		X	X		X		
MRI						X	
PEDCO[a]	X						
PJB			X		X		X
SWRI[b]		X		X	X		

[a] PEDCO was also selected to prepare the Tenax sampling media.

[b] SWRI was also selected to prepare the PUF sampling media.

SECTION 3

QUALITY ASSURANCE PROGRAM

QA/QC PROGRAM OBJECTIVES

The objective of the GCA/Technology Division contract efforts on this program was to collect representative multimedia samples which could then be analyzed in the required time frame and by the best available methods In a sense, most of GCA's work on the Love Canal Study was quality assurance--managing so as to achieve high quality results.

An important objective of the quality program was to alert the subcontractors to the importance of high quality work on their part and to demonstrate continuing concern for quality throughout the program. Measures taken by GCA to accomplish this included the provision of: general QA/QC requirements in the Requests for Proposal (RFP) for all technical work to be subcontracted; EPA's specific internal QC requirements in each analytical subcontract document; the requirement for subcontractor QA Plans; QC Coordinators with expertise in each technical area; written sampling and analysis procedures including QC requirements and planned corrective actions; Performance Evaluation and QC check samples for analytical work and, perhaps most important, continuing communication between GCA and its subcontractors.

The QA goals of the program were stated as follows:

- Collect Representative Samples
- Maintain Chain of Custody on Samples
- Analyze Samples using Appropriate Procedures
- Achieve Comparable Results from Different Analytical Laboratories
- Estimate Precision and Accuracy Achieved
- Manage and Store Sampling and Analysis Data Generated
- Report Analytical Results in a Useable Format
- Compile a Complete Project Document Inventory

DESIGN OF QA PROGRAM

The EPA laboratories listed below had designed QA/QC programs for their areas of responsibility in the Love Canal Study.

- EMSL, Research Triangle Park
- HERL, Research Triangle Park
- EMSL, Las Vegas
- ERL, Ada
- EMSL, Cincinnati

The QA/QC measures planned by these laboratories and included in their Love Canal monitoring protocols were integrated into GCA's Quality Assurance Project Plan for the Love Canal Study. The following section briefly describes the Plan.

QA PROJECT PLAN

The Love Canal Study QA Plan was tailored to the EPA's Office of Research and Development May 1980 draft of "Guidelines and Specifications for Preparing Quality Assurance Project Plans." Content requirements stated in that document were met and the format used in the appended Model QA Plan was followed. The Love Canal Study QA plan was reviewed and approved by EPA's Project Officer and the QA officers at each of the participating EPA laboratories.

The major sections of the QA Plan are listed below:

Love Canal Study QA Plan--Major Sections

1 Project Description and Organization

2 Major Program Elements

3 QA Objectives

4 Document Control Procedures

5 Chain of Custody Procedures

6 Sampling Internal QC Checks

7 Analytical Internal QC Checks

8 Precision and Accuracy

9 Data Management System

10 System and Performance Audits

11 Corrective Action Procedures

Attachments: Subcontractors' QA Plan
Format Suggestions

Appendix A: Sampling Procedures

Appendix B: Analytical Procedures

Appendix Q: Subcontractors' QA Plans

Appendices A, B and Q were contained in separate volumes and all four volumes were distributed in ring-binders to enable easy revision of individual sections as necessary. The separate volume format made it possible to provide detailed operating procedures including EPA's required internal QC procedures to the sampling and analysis subcontractors without giving them information on planned external QC measures such as performance audits. All four volumes were provided to EPA and GCA personnel.

Overall Plan

The first volume provided an overview of the quality assurance measures for the entire program and was not distributed to subcontractors. The required sampling and analysis internal QC checks were presented in tabular fashion, classified according to media sampled and pollutant class measured. The replicate sampling and analysis scheme and the external QC samples used, as well as the appropriate equations to statistically estimate the precision and accuracy achieved, were documented in considerable detail in the overall plan.

Chain of Custody and Document Control procedures specific to the Love Canal Study were developed following NEIC guidelines. The QA Plan sections on these topics were reviewed by NEIC staff members and their comments incorporated. These sections were provided to each subcontractor at the start of his subcontract activity so that uniform procedures would be followed; they were also included in Appendices A and B.

Appendix A: Sampling Procedures

This set of detailed sample collection procedures was compiled by GCA and provided to the sampling subcontractor and the supervisory geologist before any field sampling started. The manual was organized so that a specific, stand-alone procedure existed for each type of sample to be collected; the field sampler could remove and use only the procedures he needed. The appropriate type of sample container and its required cleaning, the volume or weight of sample to be collected, step by step collection procedures, field preservation and internal QC requirements, and chain of custody requirements were included in each procedure.

The complexity of the sampling program is shown by the major sections contained in Appendix A and listed below. Each section contained an overview for that media and then the individual procedures for sample collection. The procedures were dictated both by the media sampled and the analyses to be performed. It should be noted that different types of water required different sampling procedures due to equipment needs, safety considerations, preservation requirements and analytical needs.

Appendix A--Major Sections

1.0 Air Sampling

2.0 Pollutant Transport Air Sampling

3.0 Residential Water Sampling from Sumps

4.0 Drinking Water Sampling

5.0 Sewer and Drain Water Sampling

6.0 Surface Water Sampling

7.0 Ground Water and Well Core Sampling

8.0 Soil Sampling

9.0 Sediment Sampling

10.0 Biomonitoring

11.0 Field Sample Data Forms

12.0 Document Control/Chain of Custody Procedures

Procedures for quick approval and documentation of necessary changes in the field were identified early in the program. These included identifying the necessary approvals (within the subcontractor, GCA and EPA project teams), documentation of the change request and approval in Change Logs, and incorporation of the changed procedures in revisions to Appendix A.

Appendix A was a working document, revised to meet conditions found in the field. It has been thoroughly field-tested so that the third and final revision represents a valuable resource for investigation of hazardous waste sites in general.

Appendix B: Analytical Procedures

The methodology to be used in analyzing samples collected during the Love Canal Study was provided to the analytical subcontractors in two different formats before it physically became Appendix B to the QA Plan. The analysis protocols were provided as appendices to the RFP for Sample Analysis Services in Support of the Love Canal Study so that accurate cost estimates could be made by the firms bidding on the RFP. Also, the analytical protocols specific to each subcontractor formed part of that subcontract document so that procedures to be followed, including EPA's internal QC requirements, were clearly spelled out before any samples were analyzed.

GCA prepared the analytical protocol documents, researching technical questions and, if necessary, revising the subcontract protocols. These same analytical protocols were grouped somewhat differently in Appendix B than in the subcontract documents to provide the methodology and QC requirements for the entire Love Canal Study.

The major section and subsection headings are given in Table 3.1 to indicate the content and organization of the analytical procedures manual. As with the sampling procedures manual, each analytical procedure was a complete, specific protocol that could be removed and used by the analyst. Quality Control Procedures formed a subsection of every analytical protocol and were presented in both text and tabular formats.

Appendix Q: Subcontractors' QA Plans

To establish GCA's and EPA's concern for quality early in the program, each subcontractor was required to submit to GCA a QA Plan specific to his project activity. GCA provided suggested QA Plan outlines specific to sampling, analysis or geotechnical work to each subcontractor with his subcontract document or shortly thereafter. The detailed sections on Document Control and Chain of Custody procedures were also provided. Analytical subcontract documents included analysis protocols containing EPA's internal QC requirements.

The submitted QA Plans were reviewed with particular attention to these QC requirements; the review process is discussed in more detail under "Requirements for Subcontractors' QA Plans" below. Revisions were requested when necessary and the plans were conditionally approved by GCA subject to EPA's final approval. The plans were then grouped according to project activity and incorporated in their entirety in Appendix Q. This volume was distributed to EPA and the EPA Project Officer and the QA officers at the participating EPA laboratories approved the subcontractors' QA plans by their approval of the GCA QA Project Plan.

REQUIREMENTS FOR SUBCONTRACTORS' QA PLANS

Subcontractors were required to submit QA plans to demonstrate their understanding of, and capability for performing, quality work on their specific project tasks. It was not expected that different subcontractors performing the same task would submit identical QA plans but, rather, that they would meet the minimum QC requirements for that task. This would ensure that all data generated would be of at least that level of quality. It was felt that no problem would be caused by subcontractors who exceeded the minimum requirements since their data would be at or above the required level.

TABLE 3.1. APPENDIX B--SECTION HEADINGS

- 1.0 Air Analysis
  - 1.1 Overview
  - 1.2 Volatile Organic Compounds on Tenax
  - 1.3 Pesticides and Related Compounds on Polyurethane Foam Plugs
  - 1.4 Metals
  - 1.5 Dioxins
- 2.0 Water Analysis
  - 2.1 Overview
  - 2.2 Volatile Organics
  - 2.3 Semivolatile Organics
  - 2.4 Pesticides
  - 2.5 Metals
  - 2.6 Anions
  - 2.7 Total Organic Carbon
  - 2.8 Total Organic Halogens
  - 2.9 Dioxins
  - 2.10 Radioactivity
  - 2.11 pH
  - 2.12 Conductivity
- 3.0 Soil and Sediment Analysis
  - 3.1 Overview
  - 3.2 Volatiles
  - 3.3 Semivolatiles
  - 3.4 Pesticides
  - 3.5 Metals
  - 3.6 Dioxins
  - 3.7 Radioactivity

(continued)

TABLE 3.1 (continued)

- 4.0 Biota Analysis
  - 4.1 Overview
  - 4.2 Semivolatiles and Pesticides in Animal Tissue
  - 4.3 Volatile Organics in Foodstuffs
  - 4.4 Metals in Hair
  - 4.5 Metals in Vegetation
  - 4.6 Interferon in Mouse Cells
- 5.0 Data Reporting Forms
  - 5.1 Overview
- 6.0 Chain-of-Custody Procedures
  - 6.1 Document Control Procedures
  - 6.2 Chain of Custody Procedures
- 7.0 Reference Material
  - 7.1 Method 603 - Acrolein, Acrylonitrile
  - 7.2 Method 605 - Benzidines
  - 7.3 Method 608 - Organochlorine Pesticides and PCBs
  - 7.4 Method 624 - Purgeables
  - 7.5 Method 625 - Base/Neutrals, Acids and Pesticides
  - 7.6 Dioxins
  - 7.7 Qualitative Analysis by GC/MS
  - 7.8 Metals by Atomic Absorption Spectroscopy

The measures taken to ensure the adequacy and completeness of all QA Plans, and the comparability of plans prepared for the same project activity are listed in Table 3.2. The subcontractors were grouped according to their project activity as follows:

- Sampling/Analysis Preparation
- Sample Collection
- Sample Analysis
- Geotechnical Study

Subcontractor QA plans were to be submitted to GCA within 5 days of receipt of executed subcontracts; a majority of the analytical subcontractors had submitted these documents within 2 weeks. This rapid turnaround had been required by EPA and GCA in an effort to establish a firm QA/QC program prior to the start of sample analysis. However, not all of the specific information requested in the QA coordinator's suggested outline was available during this time period.

This was true primarily of the control limits and corrective actions to be used for the various analytical internal QC activities. Analytical subcontract documents issued on or about 13 August 1980 included analytical and QC procedures obtained from EPA. A number of these protocols were missing specific control limits for surrogate compound and LCS recovery. These protocols were reviewed jointly by EPA and GCA to clarify procedures and make any necessary corrections; the amended protocols were distributed on or about 2 September 1980.

Appendix B to the QA Project Plan was the final document on analytical and internal QC procedures. It contained all internal QC activities, control limits as stated by EPA and suggested corrective actions. Relevant sections of the document were distributed to all analytical subcontractors on 30 September 1980. The subcontractors were requested to review the document for inconsistencies with the protocols received with subcontract documents and to contact GCA regarding any problems with following the prescribed Appendix B procedures. No contacts were made regarding problems with meeting Appendix B requirements.

Review of all submitted analytical subcontractor QA Plans had been initiated by GCA by 2 September 1980 and continued until all plans had been reviewed. The first phase of review established that the elements of project quality assurance included in GCA's suggested outline had been addressed in each Plan and that a general understanding of the program requirements was indicated. The next phase of review looked carefully at the individual elements to determine whether responsible personnel had been identified in the areas of project management, quality assurance, document control, chain-of-custody, and corrective action. In addition, the internal QC activities were reviewed for compliance with subcontract requirements, and any

TABLE 3.2. SUBCONTRACTOR QA PLAN QA/QC MEASURES

- Suggested outlines specific to sampling, analysis, geotechnical project activity provided
- Internal QC requirements provided
- Document control heading format provided for QA Plans
- Overall Document Control system framework provided
  - Subcontractor described internal system operation and identified Document Control Officer
- Overall Chain of Custody system framework provided
  - Subcontractor described internal system operation and identified Sample Custodian
- Standardized Data Reporting Forms provided
  - Subcontractor described internal data review/reporting practices
- Corrective Action Requirements
  - Subcontractor described internal correction action system and identified individual(s) responsible for initiating action
- Review of submitted plans by GCA technical staff and/or QA Manager

variations from the governing protocols were noted. It was recognized that because control limits and corrective actions had not been delineated in all documents available to the subcontractors at the time of QA plan preparation, considerable variation in these elements could be expected.

After each plan had been reviewed, comments were summarized for each subcontractor's file and the QA Coordinator contacted the subcontractor QA officers to request clarification and/or revision when necessary. When a plan was deemed acceptable, a letter of approval by GCA conditional on EPA's final approval was sent to the subcontractor. Examples of correspondence generated by QA Plan review are presented in Appendix D, Pages D-11 through D-17. These letters document the type of actions taken by GCA to make all plans adequate, complete and comparable.

Two areas which showed intersubcontractor variation in submitted QA Plans and which might appear to impact data quality were precision and accuracy goals and internal QC procedures. For much of the Love Canal Study analytical work, there was an insufficient data base of precision and accuracy routinely achieved on samples such as those collected at Love Canal using the prescribed analytical methods. The time pressures of the study made it impossible to develop this data before analytical work commenced and so no required precision and accuracy goals could be established.

GCA felt it was consistent with the overall concern for quality to request Subcontractors to define precision and accuracy goals based on their past experience but recognized that it was not realistic to set criteria for these goals. No action was taken on this part of the submitted QA Plans other than initial review.

The time constraints of the study were involved in the internal QC procedures variation as noted above and it was decided by GCA that since the subcontract protocols and the Appendix B Analytical Procedures constituted the governing QA/QC documents for the analytical work, minor variations between subcontractors were not significant. All subcontractors were required to meet the governing documents' requirements and it was felt that no problems would be caused by laboratories exceeding those requirements.

Therefore, the QA Plans contained in Appendix Q are not identical, but all subcontractors performing the same analyses were bound to the same minimum internal QC requirements which formed, in combination with the appropriate parts of GCA's QA Project Plan, a basic and comparable QA Plan for each subcontractor. An example in which two laboratories performing the same analysis provided slightly different internal QC controls without causing problems to the quality of the data generated is given here with the prescribed procedures and control limits from the Project QA Plan Appendix B:

> In the analysis of water samples for metals, the first 0 samples of each type water were to be spiked with known amounts of the elements of interest and recovery determined. The recovery criteria were stated as follows:

Appendix B	85-115%
ERCO QA Plan	90-110% (within 10 percent of expected)
PJB QA Plan	85-115%

It is obvious that PJB responded to the Love Canal Protocol directly and that ERCO used their own standard procedure. Because the ERCO recovery range demanded better performance than that required by the Love Canal methods, the QA Plan was accepted, despite the inconsistency.

Also, as part of most laboratories' standard QC, laboratory control standards were to meet a ±2 standard deviation control limit and many of the subcontractor QA Plans so specified. These limits were stated by EPA in terms of "percentage of true value" based on repeated analyses by EPA. The subcontractors had met the requirement but were stating it in different terms than those used by EPA. Again, this type of inconsistency had no impact on data quality.

SECTION 4

QA/QC IMPLEMENTATION

GCA, through its QA Coordinator and QC Coordinators for major program elements, provided liaison between EPA and the subcontractors working on the Love Canal Study. GCA served as a conduit through which information on EPA's QA/QC requirements and questions on the implementation of these requirements could flow. Each subcontractor was responsible for implementing the QA/QC requirements appropriate to his project tasks.

One of GCA's prime concerns was providing information in a uniform manner to all subcontractors engaged in the same project activity. To accomplish this, GCA assigned staff members with appropriate technical expertise to serve as QC Coordinators for the following program elements:

- Sample Collection and Handling
- Geotechnical Study
- Sample Analysis
- Data Management System

The Sampling and Geotechnical Study QC Coordinators worked principally onsite at or near Love Canal in Niagara Falls, NY; the Analytical and Data Management QC Coordinators and the QA Coordinator worked principally at GCA's Bedford, MA facility.

This section provides a brief overview of GCA's QA/QC activities in the program areas listed above and, in addition, addresses Corrective Action, Document Control and Chain-of-Custody Procedures. The appendices to this report provide documentation as follows:

Appendix A:	Audit Reports
Appendix B:	Sampling and Analytical Internal QC Checks
Appendix C:	Corrective Action Forms
Appendix D:	Miscellaneous Supporting Information

SAMPLE COLLECTION AND HANDLING

The onsite GCA Field Office and Sample Bank were significant QA measures designed to aid in the implementation of sampling QC. Their technical staff served as sampling QC Coordinators, enabling the rapid resolution of problems as they came up in the field. Table 4.1 lists the QA/QC activities of the Field Office and Sample Bank.

The most significant activities of the QA Coordinator related to the sampling effort were the following:

- coordinating preparation of the sampling procedures manual (Appendix A)
- establishing uniform procedures for field blanks, container cleanup and preservation of samples
- identifying the approvals needed to change a sampling procedure
- setting up a Change Log at GCA and Geomet field offices
- supervising the implementation of custody requirements
- onsite system audits

Internal QC Program

The participating EPA laboratories provided QC requirements for field blanks and replicate collected samples; Geomet Technologies, Inc., the sampling subcontractor, provided operation checks for their sampling and meteorological equipment. These internal QC checks for sample collection and meteorological measurements were integrated into the QA Project Plan by GCA and presented as summary tables in Section 6 of that plan. The tables included control limits and planned corrective actions and were prepared to enable review of the sampling program internal QC measures by GCA or EPA. Section 6 is included in Appendix B to this report.

Each sampling procedure contained in the Love Canal QA Plan Appendix A included the appropriate internal QC operation check, control limits and planned corrective actions for that procedure to ensure use of these measures by field technicians. Appendix A was distributed to Geomet Technologies, Inc. who collected all samples except those related to ground water, and to JRB Associates, Inc., the supervisory geologist subcontractor, who collected ground water and well core sediment samples. Internal QC checks for Geomet's activities are summarized in Tables 6.1.1 through 6.5.1 of Section 6 in Appendix B to this report; QC checks for JRB's sample collection tasks are included in Tables 6.3.1 and 6.4.1.

TABLE 4.1. SAMPLING QA/QC MEASURES

- Standardized Sample Collection Procedures
- Each Air Collection Medium Prepared by One Laboratory from One Lot
- Onsite GCA Field Office
  - Expedited all field activities
  - Interacted with EPA and Subcontractors
  - Coordinated actual sampling operations
  - Received collected samples in the field
- Equipment Calibration Procedures/Control Limits Provided
- Onsite GCA Sample Bank
  - Directed chain of custody procedures
  - Received collected samples
  - Shipped samples to analytical laboratories
  - Inserted external QC samples in shipments
  - Maintained document control
- Documentation of Procedure/Equipment Changes
- Planned Corrective Actions
- Field Blanks and Replicate Samples Collected
- System Audits Onsite--Qualitative Overview
- Performance Audits--Air Sampling Flow Rates

Onsite System Audits

These reviews of the entire sampling operation proved invaluable. The first such system audit was conducted on 20 to 22 August 1980 and included the first day of air sampling and the second day of soil sampling by Geomet Technologies, Inc. Geomet's Field Office and GCA's Field Office and Sample Bank operations were also audited.

This audit just at the start of the sampling program provided an opportunity for field personnel to raise questions and for the QA Coordinator to identify and investigate sampling procedures which might cause analytical problems. The protocol for implementing changes in the field was established during this site visit. Confusion about field blanks was found within the Geomet staff; the purpose and handling of field blanks was discussed with both Geomet and GCA personnel. Without exception, the project team members were well-motivated and a valuable interchange of information occurred.

A second site visit by GCA's QA Coordinator on 10 to 11 September 1980 included followups on previous corrective actions and an audit of JRB Associates, Inc. ground water sample collection. Special attention was given to field blank handling, sample container cleanup and field preservation requirements.

Memos on field blank handling and container cleanup were prepared and distributed during the audit. A memo on field preservation procedures was distributed the following week, after further investigation of appropriate preservation techniques by the QA Coordinator.

A third site visit on 2 to 3 October 1980 concentrated on the geotechnical study activities but included a followup audit of ground water sample collection. Earlier inefficiencies in ground water sampling had been corrected.

The reports of these audits are contained in Appendix A to this final report. The reports were written in several sections so that a subcontractor received only the audit of his own activities and any overall summary; EPA and GCA personnel received all the sections.

Performance Audits

A flow audit of the two types of air sampling pumps and the Hi-Vol samplers used in the Love Canal Study was conducted by EPA's Quality Assurance Division from EMSL/RTP. The audit included 32 of the 92 DuPont Model P125 pumps, 36 of the 64 DuPont Model P-4000 pumps and 9 Hi-Vol Samplers. It was conducted in the field, just before and just after actual sample collection on 29 September to 1 October 1980. The audit report is presented in Appendix A to this report; it shows good agreement between Geomet's and EPA's calibration values. The Mean Percent Difference between Geomet's calibration and EPA's audit calibration for all Model P125 pumps was 2.04 percent, for all Model P4000 pumps 4.46 percent and for all Hi-Vol Samples 7.7 percent.

It is very difficult to audit water, soil and sediment sample collection when no flow or volume measurements are involved. The field blanks processed with these types of samples monitored the sample handling techniques; the samples collected in duplicate and triplicate were used to estimate overall measurement precision and audited both sampling and analytical techniques.

GEOTECHNICAL STUDY

This part of the Love Canal Study included geophysical surveys, assessment of the site geology, installation of monitoring wells, collection of ground water samples, aquifer tests, and modeling of the groundwater flow. Four subcontractors performed this work under the direction of GCA's technical monitor.

GCA's Geotechnical QC Coordinator was onsite during all active geotechnical work. His presence was particularly valuable since standard quality measures used for sampling and analysis are not readily applicable to many aspects of geotechnical work. The QC Coordinator used the onsite GCA Field Office as his base of operations and interacted with EPA and GCA project personnel and the subcontractors to expedite the geotechnical field work.

The most significant activities of the QA Coordinator related to the geotechnical study were the inclusion of sample collection procedures specific to ground water in Appendix A to the QA Plan, and the onsite audits of ground water sample collection and general geotechnical work.

Internal QC Program

The internal QC requirements for the geophysical survey consisted mainly of equipment calibration checks provided by Technos, Inc., the subcontractor conducting the survey measurements. Table 6.6.1 in Appendix B to this report presents those QC checks. Internal QC requirements for ground water and well core sediment samples collected by JRB Associates, Inc. are summarized in Tables 6.3.1 and 6.4.1 of Appendix B.

Onsite System Audits

Collection of ground water samples was audited on 10 September 1980 and again on 3 October 1980. The 2 to 3 October site visit concentrated on the geotechnical study and included field observation of drilling crews and hydrologic testing. Geophysical survey measurements were not in progress at that time but the instrument calibration procedures were observed. Appendix A to this report contains the audit reports.

The October audit showed the four subcontractors were working cooperatively and maintaining the proposed schedule despite initial start-up problems. The drilling crews were careful and conscientious in their work; the required well drilling documentation was available and up-to-date. A supervisory geologist was onsite wherever drilling was in progress.

The supervisory geologists were conscientious in maintaining field logs, taking flow rate and conductivity measurements and interpreting the split-spoon sediment samples taken at each monitoring well. The 10 September audit of ground water samples had shown some minor problems and inefficiencies which had been overcome before the 3 October 1980 audit.

Phase 1 of the geophysical survey had been completed before the 2 October site visit and was briefly reviewed during that audit. Instrument charts and manual plots of the data were available and documented in log books; the onsite calibration techniques demonstrated were in accord with the submitted QA Plan writeups.

Performance Audits

The same techniques used for other water samples--field blanks and replicate collected samples--were applied to the ground water sampling program.

SAMPLE ANALYSIS

The samples collected at Love Canal were analyzed by 12 subcontractor laboratories and 3 EPA laboratories; analysis of replicate collected samples or samples split for QA/QC purposes was conducted by 5 EPA laboratories (1 mentioned above and 4 additional laboratories). Table 4.2 lists the measures employed to ensure comparability of results between the many active laboratories.

These measures were documented in the Love Canal Study QA Plan and implemented throughout the program by all members of the project team. The subsequent validation of analytical results by EPA QA personnel showed that the planned QA/QC measures were effective in achieving comparable results from different laboratories. Internal QC analysis requirements provided analytical data for use as evaluation criteria in judging the validity of results on collected samples.

The interaction of GCA with subcontractor and EPA technical staff was invaluable. The GCA analytical QC coordinators provided liaison between the subcontractor laboratories and EPA and ensured that all laboratories received the same information. If one laboratory had a technical problem or question, the appropriate EPA project staff member was consulted and, if necessary, further research was done to solve the problem. The information gained was then supplied to all laboratories to whom it would be pertinent.

GCA's principal activities related to the analytical effort included:

- coordinating preparation of the analytical procedures manual (Appendix B)
- reviewing laboratory QA Plans

TABLE 4.2. ANALYTICAL QA/QC MEASURES

- Standardized handling and shipping procedures for all collected samples
- Standardized analysis procedures
- Internal QC Requirements specified
  - Method blanks
  - Calibration specifications
  - Calibration Checks
  - Laboratory Control Standards (LCS)
  - Internal standards
  - Surrogate compounds
  - Laboratory duplicates
- Planned Corrective Actions Outlined
- Field Blanks and Replicate Samples Analyzed
- System Audits Onsite--Qualitative Overview
- Performance Audits
  - Performance Evaluation Samples
  - External QC Check Samples

- supervising external QC program
- interfacing with EPA and subcontractors
- onsite audits

GCA's detailed knowledge of the sample collection operation enabled the prevention of analytical problems which might have been caused by sampling procedures and the quick resolution of those which had occurred. Questions which arose in field sampling or laboratory analysis were viewed from the overall measurement perspective and addressed from that viewpoint.

Internal QC Program

Internal QC measures were specified in each analytical procedure and were made a program requirement by their inclusion in subcontract documents. These QC requirements were provided by the participating EPA laboratories and integrated by GCA into the QA Project Plan; Section 7 of that plan summarized the Analytical Internal QC Checks, including control limits and planned corrective actions, for the whole program. The section was prepared to facilitate review of the QC measures by GCA or EPA staff and is included in Appendix B to this report. Table 4.3 lists the subcontractor laboratories, their analytical tasks and the table in Section 7 which includes the appropriate Internal QC Checks for each task. It can be seen that different laboratories performing the same analyses were required to implement the same internal QC measures.

Each analytical procedure contained in the Love Canal QA Plan Appendix B included the same QC operation checks, control limits, and planned corrective actions as those listed in the summary tables. Each subcontractor received the sections of Appendix B which were relevant to his project task. However, in some cases, the control limits were not included in subcontract documents because a data base sufficient to derive this information did not exist. GCA worked with EPA in defining control limits when required; this section discusses such efforts.

The role of GCA in establishing and conducting the internal QC program of the Love Canal Study is described below for each medium. Despite its seeming to be a rather routine matter of passing on information from one organization to another, the time constraints placed on project start-up and the need to coordinate activities of 5 EPA laboratories, 12 analysis subcontractors and 2 analytical QA subcontractors proved hectic in the early weeks of the program. Many of the internal QC measures and control limits were finalized as subcontracts were being prepared and required considerable discussion with EPA personnel, the potential subcontractors and members of GCA's analytical staff. After all analytical and quality control procedures had been established and the program was underway, similar discussions occurred if analytical subcontractors or EPA noted chronic problems with a measurement or sample type. Substantial effort was dedicated to keeping the subcontractors apprised of analytical problems encountered by other laboratories which were

TABLE 4.3. ANALYTICAL SUBCONTRACTOR INTERNAL QC REQUIREMENTS

Subcontractor	Analysis task	Summary table[a]
Battelle Columbus Laboratories	Volatile organics on Tenax	7.1.1
PEDCo Environmental, Inc.	Volatile organics on Tenax	7.1.1
Gulf South Research Institute	Pesticides on polyurethane foam	7.1.1
	Organics in water	7.2.1
	Organics in soil and sediments	7.3.1
Southwest Research Institute	Pesticides on polyurethane foam	7.1.1
	Inorganics in water	7.2.1
	Organics and inorganics in soil and sediments	7.3.1
	Organics and inorganics in biota	7.4.1
Compuchem/Mead Technology Laboratories	Organics in water	7.2.1
	Organics in soil and sediments	7.3.1
PJB/Jacobs Engineering Group	Inorganics and organics in in water	7.2.1
	Inorganics and organics in soil and sediments	7.3.1
TRW, Inc.	Organics in water	7.2.1
Acurex Corporation	Organics in water	7.2.1
	Organics in soil and sediments	7.3.1
Energy Resources Company, Inc. (ERCO)	Inorganics in water	7.2.1
	Inorganics in soil and sediments	7.3.1
Midwest Research Institute	Organics in biota	7.4.1
Wright State University	Dioxin in all media	7.1.1, 7.2.1, 7.3.1
Advanced Environmental Systems, Inc.	TOC/TOX, pH, Conductivity in ground waters	7.2.1

[a]Refers to Table in Section 7 in Appendix B of this report.

relevant to their own activities on this project. Likewise, EPA personnel were informed of analytical problems requiring their action and, as necessary, were updated on current progress by the subcontractors.

GCA technical staff members maintained project notebooks documenting their activities on the Love Canal Study. These notebooks are part of GCA's project document inventory which will be turned over to EPA after the submission of GCA's Final Report on the program. Excerpts from these notebooks giving examples of actions taken by GCA are given below. It is expected that these examples will serve to highlight some of the more important aspects of GCA's involvement in the study and will demonstrate the variety of activities conducted in fulfilling the needs of so diverse a study.

Air--

The monitoring program for ambient air samples collected in the Love Canal area was designed to provide information on three types of chemical substances. Each general class of pollutants* required its own specific sample collection method resulting in three distinct sample types, each with a prescribed method of analysis and differing QC requirements. In addition, QC requirements were specified by the EPA laboratories involved in the air monitoring program. Volatile organic compounds were collected on Tenax-GC resin and their monitoring was the responsibility of EMSL/RTP. Pesticides and related compounds were collected on polyurethane foam plugs in a segment of the program supervised by HERL/RTP, and metals were monitored on hi-vol filter samples under the direction of another group at EMSL/RTP. These three groups designated different degrees and areas of responsibility to GCA for the performance of air monitoring QA/QC.

Tenax cartridges--Selected volatile organic species were measured in ambient air as part of the Love Canal Study. Samples were collected by drawing specified volumes of air through glass cartridges packed with Tenax-GC. Analysis of these cartridges, or traps, was then accomplished by thermally desorbing the Tenax into a GC/MS system for quantitation and identification of the specified compounds.

GCA's role in the implementation and day-to-day management of this program consisted of collection and subsequent distributing of the analytical data and monitoring the internal QC data. In consultation with technical personnel from EMSL/RTP, GCA's initial responsibility was to perform tasks such as select analytical subcontractors, purchase a large quantity of Tenax-GC (7 kilograms) from a single production lot, and select a subcontractor to prepare the cartridges. The eventual subcontractors and their roles were as follows:

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*Refer to Appendix D (pp. D-2) for compound hit lists and explanation of terms used for compound classes.

- Research Triangle Institute (RTI) prepared standard calibration cartridges as well as blind quality assurance spiked traps. RTI was also responsible for checking background level contamination of trap batches.
- PEDCo Environmental was selected as an analytical subcontractor. PEDCo was also responsible for preparing the traps by first cleaning the Tenax and then packing the tubes and checking each batch of tubes for background contamination.
- Battelle Columbus Laboratories was selected as an analytical subcontractor.
- IIT Research Institute (IITRI) was chosen to perform analyses on calibration and check traps for accuracy and precision.

At a meeting in Research Triangle Park on 26 September 1980, a discussion of problems associated with the analyses was held. Attending the meeting were representatives from EPA, GCA, Battelle Columbus Laboratories, PEDCo Environmental, and Research Triangle Institute. Problems in shipping, broken traps, benzene and toluene contamination of the Tenax, and problems with meeting QC criteria, especially by Battelle, were discussed. Resolution of some of these problems was accomplished as described below.

To ensure compliance with column performance specifications, PEDCo was to purchase a capillary column from Battelle. Also, GCA was to inform its sampling subcontractor to pack traps more securely in their culture tubes after sampling. This resulted in a drop in the breakage rate, although some inevitable damage still occurred.

Problems with low levels of benzene and toluene contamination of the Tenax (approximately 20 ng/tube) continued throughout the program. QC monitoring of one batch of tubes (PEI-0) resulted in the recleaning of the batch because of high contamination levels. It was determined that low levels of contamination could not be prevented and blank subtractions were applied to all samples. In addition, because contaminant levels were observed to rise with the age of the tube, strict monitoring of the 30-day limit between tube preparation and analysis was observed.

It was also determined at the meeting that GCA would find another analytical subcontractor to perform analysis on standard and check traps to determine their precision and accuracy. In early October 1980, GCA contacted IIT Research Institute requesting quotes on analytical services to include the analysis of nine traps (six standards and three quality assurance traps). IITRI was not to be notified of concentrations of compounds in the traps, rather, they were to set up calibrations using their own systems and to quantitate versus these calibrations. In this manner, a check would be made on the standards preparation. GCA amended the contract of RTI to provide a redistribution of QA and standard traps to facilitate this test. This effort resulted in the external verification of 3 batches of spiked tubes (from a total of 12 batches). Results of these analyses were to be submitted to GCA within 7 days of the analysis and forwarded to EMSL/RTP. IITRI was selected as subcontractor for this work and received their first set of samples on 28 October 1980.

On 7 and 8 October 1980, on-site audits of both the Battelle and PEDCo facilities were performed by representatives of GCA and EMSL/RTP. At that time, it was determined that Battelle's previously identified problem with lack of precision in their calibration check samples was due to a septum leak in the Nutech thermal desorber, an idea presented at the RTP meeting. (For further information on this audit, see Appendix A.)

GCA continued to monitor the quality control sample results for both subcontractors following the audits. At the request of EMSL/RTP, results of all calibration check samples were submitted verbally as soon as available to GCA. After compilation and statistical analysis, these data were then relayed to EMSL/RTP where potential or existing problems were discussed. This compilation of data continued until the end of the program.

GCA distributed field samples to the subcontractor labs so as to prevent overloading and to enable the labs to meet the stringent time compliance requisites for the analysis. As previously mentioned, monitoring of analysis dates was necessary due to contaminant levels. GCA established a schedule involving tube preparation, background determination, standard tube spiking, sampling, and analysis. Using chain of custody and shipping documentation, each batch of tubes was monitored to ensure that all traps were sent to the analytical laboratories no more than 10 days after preparation and were analyzed within 20 days of receipt.

GCA also served as an informational intermediary for EPA, gathering such data as spiking techniques for both standards and internal standards, specifics on tube preparation, levels of contaminants, and quantitative techniques. Problems encountered by the subcontracting laboratories were relayed through GCA to EPA, and, when required, followed up by GCA personnel and resolved in consultation with EMSL/RTP. For example, PEDCo had analyzed several tubes with high enough concentrations of a compound to cause instrument shutdown. After consultation with EMSL-RTP, it was determined that the problem compound was water, which had been trapped on the tube during sampling. Visual examination of the problem tubes prior to analysis had shown some moisture in the culture tubes enclosing the traps. A check of meteorological data from the sample date confirmed high humidity. To rectify the problem, it was decided that any traps showing condensation would first be dried in the culture tubes with sodium sulfate. No further problems of this sort were encountered.

Finally, GCA was requested by EMSL/RTP to obtain data on absolute area counts for internal standards spiked onto each sample tube by the subcontracting laboratories. Battelle had submitted this as part of its data package, and a slight modification to the computerized data reading algorithm allowed this listing. PEDCo, however, had not included this data and a further subcontract was awarded to complete this listing.

Polyurethane foam plugs (PUFs)--The analytical procedure for pesticides in polyurethane foam plugs was initially provided to the subcontracting laboratories in the Appendices to the analytical RFP. This method package had been obtained from HERL/RTP, the EPA laboratory responsible for this program area. It included extraction, concentration, clean-up and EC-GC procedures but did not address the specifics of quality control. Extensive discussion was required to establish a QC program which would be satisfactory to the goals of HERL and the overall project and which could also be reasonably met by the analytical subcontractors. One of GCA's analytical QC coordinators was responsible for initiating this discussion with HERL and, as necessary and as requested by HERL, obtaining input from the PUF subcontractors regarding reasonable frequency and control limits. While the ultimate decision for this area of the study was made by HERL, the subcontracting laboratories also were involved in designing the internal QC program. GCA served as a mediator and was responsible for all parties involved having correct and complete information. This series of information exchanges culminated in correspondence from HERL/RTP to GCA on August 27, 1980. This memorandum served to clarify and confirm internal QC procedures for the polyurethane foam plugs analyses. Summaries of entries in Notebook No. 1-619-026-124 of the Analytical QC Coordinator responsible for establishing and implementing this area of the program, illustrate GCA's role as follows:

Date	Notebook Entry
8/10/80	This first entry regarding PUFs analysis was primarily an exchange of information within GCA. Ms. B. Myatt was preparing analytical protocols for inclusion in subcontract materials and needed the internal QC procedures thus far established by EPA-HERL in consultation with Dr. S. Zelenski of GCA. It was determined that one (1) method blank and one (1) spike recovery would be processed with each batch of extracts and that acceptable recovery ranges would be established by data collected in the Love Canal Study.
8/12/80	It was recognized that several items of QC specified in other protocols were not included in the PUFs analysis. These included standardization and calibration of the instrument(s), a list of compounds to be used in lab control standards (LCS) and the use of surrogates or replicates. A series of conversations were recorded between Ms. Myatt and Dr. Zelenski, Merrill Jackson of HERL and Randall Watts of HERL. Details of the requisite QC operations were given and the QC protocol for inclusion in the PUFs subcontracts was delineated.
8/22/80	Some questions had arisen within GCA as to whether some of the internal QC requirements were too stringent (i.e., calibration check every 2 hours when only running one sample per hour by GC). Discussion with Dr. K. McGregor of GCA and Dr. R. Lewis of HERL led to Ms. Myatt's being asked to contact the two analytical subcontractors involved to get their opinions on appropriate calibration and standardization procedures to meet

quality needs and also to be consistent with the sample througput required. Also, analysis of phenols by HPLC had been approved in the RFP for this task but GCA was having difficulty obtaining the method which was still in the prepublication stage. If the subcontractors were not using the HPLC, it would be omitted from the analytical methods manual.

8/22/80 and 8/25/80 Telecons with Dr. E. McGovern of SWRI and Dr. R. Novak of GSRI were recorded. These communications summarized each laboratory's usual standardization procedures for GC and recorded their agreement to meet required instrument response and detection limits. Points were brought up (internal standard) which necessitated further discussion with HERL/RTP.

8/26/80 Telecons with R. Watts and M. Jackson of HERL and McGovern and Novak were recorded. Information was transmitted regarding achievable standard checks and possible compounds for internal standards. The subcontractors were contacted directly by HERL to finalize details. HERL was to call B. Myatt regarding the resolution.

8/27/80 R. Watts of HERL called B. Myatt to give final standardization procedures and QC limits. The HPLC method was released and assigned an EPA report number, and correction factors for compound collection efficiency were transmitted. The memorandum cited above was written and sent to GCA as confirmation of the finalized procedures. It included the PUF sampling and HPLC analytical procedures. M. Jackson of HERL was contacted regarding shipment of standard compounds to the two subcontractors. Appropriate chain of custody forms were sent to him, and the addresses to which materials were to be sent were transmitted.

This documented the set-up of the internal QC program for analysis of air samples collected on polyurethane foam plugs. Following this start-up and implementation, GCA's role in the PUFs analysis became one of managing sample distribution and analysis and acting as go-between for questions initiated by EPA or the subcontracting laboratories. Very few questions arose in these analyses. Monitoring of internal QC data was the responsibility of EPA-HERL/RTP.

Hi-Vol Filters--The analysis of hi-vol filters for selected metals was an area of the Love Canal Study under complete control of the EPA laboratory (EMSL/RTP). This program was not subcontracted through GCA but was conducted totally by EMSL/RTP. GCA requested that, for the sake of completeness, the analytical procedures and appropriate QC measures be provided for inclusion in Appendix B to the Project QA Plan. These were received from EPA and formatted to be compatible with Appendix B. Through a recently discovered oversight, the Neutron Activation Analysis procedure used for Arsenic was not included. However, a written analysis procedure was followed and will be included as an attachment to GCA's Final Report. Data sheets and a Coding Manual were provided to the EPA analytical laboratory so that results could be included in the Love Canal Study data base. Monitoring of the laboratory's performance of QC activities was the responsibility of EMSL/RTP.

Water--

The water monitoring program for the Love Canal Study was performed under the direction of several EPA laboratories and included the analysis of sump, ground, drinking, sewer, and surface waters for selected parameters and pollutant classes. The analytical and QC procedures were specified by these EPA laboratories and were incorporated into analytical subcontracts and Appendix B by GCA. Radioactivity measurements were made by EMSL/LV and did not involve GCA. However, the radioactivity procedure was supplied to GCA for inclusion in Appendix B for the sake of completeness of the manual. The measurement of volatile organics,* semivolatile organics, pesticides, metals, and the anions fluoride and nitrate was conducted according to a protocol developed primarily by EMSL/Cincinnati, although EMSL/LV also played a role in determining analysis and QC. Total organic carbon (TOC), total organic halogens (TOX), pH and conductivity were performed only on ground water samples as directed by the R. S. Kerr Laboratory, ERL/Ada. Selected samples were analyzed for TCDD as specified by HERL/RTP.

The role of GCA in the water monitoring program was primarily to combine the analytical and QC procedures provided by EPA into a comprehensive package for use by the subcontracting laboratories. As necessary, GCA fielded questions from EPA or the subcontractors and obtained answers from the appropriate parties involved. Several examples of these problems, resolutions and contract management are given below:

Date	Notebook Entry
8/13/80	Many of the subcontracts pertaining to water analysis were sent out to the appropriate analytical laboratories. The procedures and internal QC protocol were those specified by EMSL in several documents (memoranda, draft reports) given to GCA.
8/18/80	K. McGregor of GCA met with EMSL scientists regarding methods clarifications. Surrogate compounds, internal standards and LCS compounds were specified, and comments on the methods documents that were in the subcontracts were taken for incorporation into final protocols.

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*Refer to Appendix D (pp. D-2) for compound hit lists and explanation of terms used for compound classes.

8/21/80	K. McGregor met with M. Kozik and B. Myatt of GCA to instruct them to make these changes. Of significance was the change in analysis of selenium and arsenic. The original methods called for selenium by ICP and arsenic by flameless AAS. The final methods reversed these two elemental analyses. In addition, the analysis of soil/sediment by ICP was no longer permitted; only AAS could be used for soil/sediment samples.
9/2/80	The updated methods packages were distributed to analytical subcontractors, as appropriate.

Date	Notebook Entry
8/4/80	B. Myatt was requested by R. M. Ellersick to call ERL/Ada for the analytical and QC procedures for TOC and TOX.
8/5/80	B. Myatt had telecon with Craig Shew of ERL/Ada. TOC was to be performed by the standard EPA Method from EPA-600/4-79-020. TOX was defined as titratable chloride, similar to TOC. Shew believed that the subcontractor, AES, was using a Dohrmann apparatus and suggested that AES be contacted directly for their procedure.
8/5/80	B. Myatt contacted AES to request a copy of their TOX procedure. The document was received 8/10/80.
8/26/80	R. M. Bradway and B. Myatt discussed which samples required TOC and TOX analyses and Optional Forms 60 were requested from AES prior to preparation of the subcontracts.
8/29/80	The analytical subcontracts for TOC and TOX were transmitted to AES.
10/15/80	R. M. Ellersick of GCA questioned the standardization procedure AES was using for the TOX analyzer after discussion with G. Smith of ERL/Ada. She requested that further information on recommended procedures be obtained from Dohrmann.
10/17/80	B. Myatt spoke with John Whitechurch of Dohrmann who judged that the AES procedures seemed to be acceptable. This information, along with Dohrmann's prescribed standardization and analytical procedures, was transmitted to R. M. Ellersick.
10/21/80	R. M. Ellersick prepared a memo reporting the follow-up to the original QA audit of the TOX Subcontractor. Four points of TOX standardization were listed. Three had been followed by the subcontractor since the beginning of the program. The fourth, which consisted of correcting data for percent recovery by the analyzer, would be followed from this date on. GCA would correct data already submitted.

2/25/81 Corrective Action Request Form No. LC-1-619-026-024 by R. M. Ellersick (found on p. C-38 of Appendices to this report) details events surrounding AES correction of data submitted prior to 10/21/80. Corrections were in error and considerable communication was required with the subcontractor, Dohrmann and GCA before final data was obtained and verified.

Date	Notebook Entry
9/9/80	B. Myatt received telecon from K. Hausknecht of ERCO regarding water samples received for inorganic analyses. The internal QC program required that the first 10 samples of each type of water be spiked with known amounts of the elements of interest to determine if interferences were present. The first batch of samples received by ERCO did not have any identification of water type (i.e., sump, sewer, drinking), thereby delaying the start of the analytical program. R. M. Ellersick was notified and informed the Sample Bank to note water type on sample tags from this point on and to call the laboratories which had received samples to give them sample type information on those samples already received.

GCA's role in the water monitoring program was again primarily to implement the analytical and QC protocols specified by several EPA laboratories. This often required numerous discussions to clarify details of analytical methods and control limits for internal QC. Data reports were sent directly from the analytical subcontractors to the appropriate EPA laboratories concurrently with subcontractor submission of data to GCA. GCA acted as go-between for EPA and subcontractor questions and comments but did not review internal QC data for quality.

Soil/Sediment--

Soil and sediment samples were analyzed in a program directed by EMSL/LV. Compounds and elements measured by analytical subcontractors included volatile, semivolatile, and pesticide organics,* metals and TCDD. Prior to the performance of the complete Love Canal Study, a methods evaluation program was conducted for semivolatile organics. GCA was responsible for setting up the analytical and internal QC protocols for all methods in the evaluation based on EPA requirements. Subcontracts were then written so that two laboratories (Acurex and SWRI) were involved in the evaluation and an additional three (PJB, GSRI and Compuchem) were subcontracted to perform the analyses by the method chosen. GCA managed both phases of this program. All decisions regarding the method of choice and the quality of analytical data were ultimately made by EMSL/LV in concert with GCA. As described for other media, the GCA role was one of coordination between EPA and the analytical subcontractors. An example of GCA's involvement in this program area is given below:

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*Refer to Appendix D (pp. D-2) for compound hit lists and explanation of terms used for compound classes.

Date	Subject
10/7/80	GCA received a call from D. Sauter of EMSL/LV requesting that data from one of the analytical subcontractors be evaluated for quality since results for several samples were suspiciously low in organic compounds. One of GCA's senior organic chemists (G. T. Hunt) was requested to pursue this matter.
10/9/80	G. Hunt submitted memo to R. Bradway and K. McGregor summarizing Sauter's comments on the data and his own review of the data package. He also documented a telecon to the subcontractor laboratory and his recommendations for further investigation.
10/10/80	R. M. Ellersick memo to R. Bradway and K. McGregor summarized actions to be taken regarding the data from this laboratory. These included obtaining surrogate recovery data from other analytical subcontractors and possibly scheduling a site visit to the laboratory in question.
10/16/80	A meeting was held at EMSL/LV and was attended by K. McGregor and G. Hunt of GCA and several EMSL/LV staff members involved in the Love Canal Study. Its purpose was to determine what actions should be taken regarding the problem laboratory. Foremost was to perform an onsite audit of the laboratory to establish whether the data in question was, in fact, unacceptable. In addition, the timely redistribution of this laboratory's sample load (should it be necessary) and treatment of data thusfar submitted were discussed.
10/17/80	K. McGregor, G. Hunt and D. Sauter of EMSL/LV traveled to the suspect laboratory to discuss internal QC practices and problems they may have been having.
10/21/80	G. Hunt memo to K. McGregor and R. Bradway summarizes the site visit, its conclusions, and actions to be taken thereon. The volatiles and pesticides data were judged acceptable. The semivolatile results were unacceptable and the subcontractor was requested to send one half of each semivolatile extract to GCA for further disposition. After demonstrating satisfactory performance on QC samples, the subcontractor was to rerun each of the 75 sample extracts thus far analyzed. No further samples would be sent to this laboratory until QC problems were rectified.
2/5/81	Corrective Action Request Form No. LC-1-619-026-020 by R. M. Ellersick (found on p. C-28 of the appendices to this report) documents this complete series of events. Extracts sent to GCA were to be retained and, if necessary, analyzed by GCA. The subcontractor was successful in providing acceptable QC data

and reran the original 75 extracts, thereby eliminating the need for GCA to analyze these samples. No additional samples were sent to the subject laboratory because the program was completed by the time acceptable QC was proved.

In addition to the analysis of the volatile, semivolatile, and pesticide organics, and metals monitored by EMSL/LV, TCDD and radioactivity were measured in selected soil/sediment samples. As with the water medium, the TCDD measurements were performed by an analytical subcontractor in a program monitored by HERL/RTP. Similarly, radioactivity analyses were performed by EMSL/LV and the procedures submitted to GCA for inclusion in the manual (Appendix B). GCA managed the TCDD subcontract but did not participate in data evaluation.

Biota--

The analysis of biological materials in the Love Canal Study was primarily the result of a program conducted under the direction of EMSL/LV. As in other media, GCA set up the analytical and internal QC protocols for subcontracts under the direction of the EPA laboratory. GCA then served as manager of the subcontracts, fielding EPA and laboratory questions on analysis and data reporting. During the course of the program, it was noted that isophorone was the major organic component observed in the biota samples. Because acetone was used in the procedure, GCA conducted an experimental program to determine the extent of artifactual formation of acetone derivatives during biota sample preparation. This study is described more fully below.

The original RFP from GCA to potential analytical subcontractors included the analysis of semivolatile and pesticide organics* in animal tissue. Two methods were being considered and the decision on which to use was made by EPA prior to the preparation of subcontract documents. Internal QC procedures applied to these organic analyses consisted of general items such as GC/MS tuning and calibration, method blanks and replicates and additional activities specified by EMSL/LV (i.e., reagent purity verification and extraction efficiency testing). Additional QC data was generated by a study conducted prior to the start of field sample analysis. MRI, the subcontractor chosen for the animal tissue analyses, was required to procure mice, crayfish, and earthworms from a local (Missouri) source and to use these animal tissues in a study of blank levels of the hit list compounds and recovery of selected compounds spiked into the tissues. The recovery program consisted of eight hit list compounds spiked into nine samples (three each of mice, worms, crayfish) at two concentration levels with analyses performed by the subcontract extraction method and GC/Hall. Data from the recovery study were used to set analytical control limit specifications.

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*Refer to Appendix D (pp. D-2) for compound hit lits and explanation of terms used for compound classes.

The measurement of volatile organics in foodstuffs and metals in hair and vegetation samples was not included in the GCA RFP to analytical subcontractors. In the course of the Love Canal Study, these methods were finalized by EPA, the number of samples determined, and the details of internal QC set through numerous conversations with EMSL/LV. Prior to these subcontracts being let, GCA was instrumental in identifying omissions or inconsistencies in the internal QC requirements. One such situation is described in the example below.

Date	Notebook Entry
10/6/80	B. Myatt, D. Chase and G. Hunt obtained information from GCA Contracts Office regarding the numbers of samples for inorganics in hair and vegetation and volatile organics in foodstuffs. Analytical procedures were verified through EMSL/LV and bids were solicited from available subcontractors.
10/10/80	B. Myatt received quote from one subcontractor and also spoke with Dr. S. Black, EMSL/LV, about the number of hair and vegetation samples currently planned for inorganic analyses and what internal QC would be required. The numbers of method blanks, spiked samples and LCS to be run with each batch of samples for inorganics were specified. In addition, external QA was determined to be conducted by extracts of several samples being split and one half of each sent to an EPA laboratory for concurrent analysis.
10/15/80	The analytical subcontract for inorganics in hair and vegetation was let based on the number of samples specified by Dr. S. Black.
10/22/80	The internal QC procedures for volatile organics in foodstuffs were discussed by B. Myatt and S. Black. Resolution was reached on surrogates, laboratory control standards and control limits. Internal standards were not applicable to the prescribed analytical procedure. A subcontract was issued for these analyses using the analytical and QC procedures determined this date.

In the spring of 1981, GCA conducted a study initiated by direction from the EPA to determine the extent of artifactual production of acetone derivatives during Soxhlet extraction of environmental samples. The results of this study included both theoretical and experimental data concerning the formation of acetone derivatives as well as data obtained from the examination of GC/MS results for the Love Canal biota samples for the presence of possibly artifactual acetone derivatives.

Initially, data from two biota samples analyzed by capillary GC/MS and found to contain significant levels of isophorone were examined for the presence of acetone derivatives and for verification of the presence of isophorone. The samples selected were B30039 (crayfish) and B30078 (mouse).

Subsequently, several experiments were performed simulating the conditions found in a Sohxlet extractor and measuring the production of isophorone. Several conclusions from the study were made, including

- Isophorone is formed in the soxhlet extraction of both acidic and basic purified sand in significant amounts.
- The mass spectral data from the biota samples indicated the presence of acetone derivatives such as mesityl oxide, diacetone alcohol, phorone and isophorone.

Most importantly, the very real possibility of isophorone production in the sohxlet extraction of the biota was raised. A summary report entitled Investigation of the Artifactual Formation of Acetone Derivatives in Biota Samples from the Love Canal Study was submitted by GCA to EMSL-Las Vegas in May 1981.

Control Chart Requirements

GCA included in its Requests for Proposal for analytical tasks, and in the analytical subcontract documents a section of general QA/QC requirements for the subcontractor. These requirements included the maintenance of control charts on instrument calibration and on known QC samples, such as Laboratory Control Standards (LCS). The analytical protocols for specific analyses which were included in subcontract documents and in the QA Plan Appendix B, in most cases, stated that control charts should be maintained for LCS. The laboratories were required to report their results on LCS (as well as known QC samples, surrogate compounds and internal standards) on Coding Form A2: Internal QC Report. The LCS control chart data is therefore part of the data base for the Study.

Although the subcontracts did not specify the control charts per se (plotted LCS data) as "deliverables," some subcontractors did provide them to GCA. Examples of hard copy control charts submitted by the laboratories are shown in Appendix D to this report on pages D-19 through D-26. Several parameters were charted. Examples shown demonstrate control charts on laboratory control standards (from ERCO, pages D-19 through D-22), on surrogate standard recoveries from soils, sediments and waters (from GSRI, pages D-23 through D-26), and on internal standards (from GSRI, Page D-27).

As can be noted from the internal standard charts, the charts were a good indicator of problem areas. On 12 November 1980 technicians at GSRI observed a problem in the relative molar response (RMR) of chrysene to its deuterated analog. The problem was traced to a faulty transfer line heater in their GC/MS system and repairs were made. Subsequent measurements showed a return to the nominal condition after the repairs.

Laboratory Site Visits/System Audits

Each laboratory was visited by GCA or EPA or both during the first month of analytical work and the working relationship established then proved valuable throughout the study. These visits constituted system audits of each laboratory's operations for the Love Canal Study; examples of the audit reports are contained in Appendix A to this report. Internal QC records were inspected and chain of custody procedures were reviewed. These site visits were particularly useful in identifying and resolving sample preparation and analysis problems early in the analytical effort.

External Quality Control Program/Performance Audits

Well-characterized samples whose true values were not known to the subcontractor laboratories were submitted to each laboratory throughout the program for use in evaluating overall performance and in estimating the accuracy achieved by each laboratory. These QC samples were shipped to the GCA Sample Bank at Niagara Falls to ensure that they were handled in the same way as collected samples. However, the objective of having these QC samples indistinguishable from collected samples was only achieved with the tenax cartridges and polyurethane foam plugs used for air sample collection. The other QC samples were easily recognizable as different from collected samples.

Two general types of QC samples were used: Performance Evaluation Samples and External QC Check Samples. The differences between the two types of samples are briefly described below and the individual samples are listed in Tables 4.4 and 4.5.

Performance Evaluation (PE) Samples--

These samples were provided by EMSL-Cincinnati and EMSL-Las Vegas as "double-blinds" (true values unknown to both GCA and the subcontractor laboratories) for use in the water, soil, sediment and biota monitoring programs. Analytical results on these samples were sent directly to the providing EPA laboratories where they were evaluated as Acceptable or Not Acceptable for each analyte reported.

EMSL-Cincinnati provided three different groups of PE samples to be shipped to appropriate laboratories at monthly intervals during the analytical work. The samples were concentrated solutions and instructions for dilution before analysis were included. GCA's QA Coordinator and Analytical QC Coordinators checked on prompt submission of results and, more importantly, investigated any Not Acceptable results. EMSL-Cincinnati sent their evaluation reports to GCA to enable this follow-up. All Not Acceptable results were checked with the individual laboratory and corrective actions initiated as necessary.

TABLE 4.4. PERFORMANCE EVALUATION SAMPLES USED FOR LOVE CANAL STUDY

Sample source	Sample contents/matrix/use	Laboratories receiving samples
EMSL-CINN	14 Trace Metals for AA Analysis/Aqueous Solution/Water, Soil, Sediment Samples	Energy Resources Company, Inc. (ERCO) PJB/Jacobs Engineering Group, Inc.
EMSL-CINN	14 Trace Metals for ICP Analysis/Aqueous Solution/Water, Soil, Sediment Samples	ERCO PJB/Jacobs Engineering Group, Inc.
EMSL-CINN	Nitrate, Fluoride/Aqueous Solution/Water Samples	ERCO PJB/Jacobs Engineering Group, Inc.
EMSL-CINN	Total Organic Carbon (TOC)/Aqueous Solution/ Ground Water Samples	Advanced Environmental Systems, Inc.
EMSL-CINN	12 Volatile Organic Compounds/Methanol/ Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute PJB/Jacobs Engineering Group, Inc. Southwest Research Institute TRW, Inc.
EMSL-CINN	12 Semivolatile Organic Compounds/Solution/ Water, Soil, Sediment, Biota, Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute Midwest Research Institute PJB/Jacobs Engineering Group, Inc. Southwest Research Institute TRW, Inc.

(continued)

TABLE 4.4 (continued)

Sample source	Sample contents/matrix/use	Laboratories receiving samples
EMSL-LV	12 Semivolatile Compounds +5 Pesticides/ NBS River Sediment/Soil and Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute PJB/Jacobs Engineering Group, Inc. Southwest Research Institute
EMSL-CINN	8 Pesticides/Acetone/Water, Soil, Sediment, Biota Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Midwest Research Institute PJB/Jacobs Engineering Group, Inc. Southwest Research Institute TRW, Inc.
EMSL-LV	5 Pesticides/NBS River Sediment/Soil and Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute PJB/Jacobs Engineering Group, Inc. Southwest Research Institute

TABLE 4.5. EXTERNAL QC CHECK SAMPLES USED FOR LOVE CANAL STUDY

Sample source	Sample contents/matrix/use	Laboratories receiving samples	Comments
EMSL-RTP	10 Trace Metals/Hi Vol Filters/Air Samples	EMSL-RTP	7 metals on LC[a] Monitoring List. Lab reported Sb and Be (not present); did not report Ba (present).
Research Triangle Institute	6 Volatile Organics/Tenax/Air Samples	Battelle Columbus Laboratories IIT Research Institute PEDCO Environmental, Inc.	Sample specific to LC;[a] looked like a collected sample.
HERL-RTP	6 Semivolatile Organics/Polyurethane Foam/Air Samples	Gulf South Research Institute HERL-RTP Southwest Research Institute	Sample specific to LC;[a] looked like a collected sample. Data handling problem at GCA.
EMSL-CINN	18 Trace Metals for AA Analysis/Aqueous Solution/Water, Soil, Sediment Samples	ERCO PJB/Jacobs Engineering Group, Inc.	13 metals on LC[a] Monitoring List. 2 concentrations below LC[a] detection limits for 7 to 8 metals. EMSL-CINN verified true values.
EMSL-CINN	18 Trace Metals for ICP Analysis/Aqueous Solution/Water Samples	ERCO	13 metals on LC[a] Monitoring List.
EMSL-CINN	Nitrate, Fluoride/Aqueous Solution/Water Samples	ERCO PJB/Jacobs Engineering Group, Inc.	Labs inconsistent in reporting nitrate as N.
EMSL-CINN	9 Volatile Organic Compounds/Solution/Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute Southwest Research Institute TRW, Inc.	One concentration inappropriate for LC[a] procedures. Replaced by purgeable organic compounds sample.
EMSL-CINN	6 Purgeable Organic Compounds/Solution/Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute PJB/Jacobs Engineering Group, Inc. Southwest Research Institute TRW, Inc.	Sample specific to LC.[a] Xylene isomers not readily separable; labs reported different isomers coeluting.
EMSL-CINN	Phenol/Solution/Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South research Institute Southwest Research Institute	Inappropriate QC sample for LC[a] analysis procedures. True values verified by EMSL-CINN. Replaced by Semivolatile, Acid Extract Sample. SwRI instructed not to analyze.

(continued)

TABLE 4.5 (continued)

Sample source	Sample contents/matrix/use	Laboratories receiving samples	Comments
EMSL-CINN	5 Semivolatile, Acid Extract Compounds/Solution/Water, Soil, Sediment Samples	Compuchem/Mead Technology Laboratories Gulf South Research Institute PEDCO Environmental, Inc. PJB/Jacobs Engineering Group, Inc. Southwest Research Institute TRW, Inc.	Sample specific to LC.[a] PJB did not analyze--no similar collected samples. Compuchem did not analyze--lab handling error.
EMSL-CINN	9 Semivolatile, Base/Neutral Extract Compounds/Solution/Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research institute PJB/Jacobs Engineering Group, Inc. Southwest Research Institute TRW, Inc.	Sample specific to LC.[a] PJB did not analyze--no similar collected samples.
EMSL-CINN	7 Chlorinated Hydrocarbon Pesticides/Solution/Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute TRW, Inc.	Inappropriate QC Sample for LC[a] analysis procedures. Replaced by 6 Pesticides sample.
EMSL-CINN	6 Pesticides/Solution/Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute PJB/Jacobs Engineering Group, Inc. Southwest Research institute TRW, Inc.	Sample specific to LC.[a]
EMSL-CINN	1 PCB/Solution/Water, Soil, Sediment Samples	Acurex Corporation Compuchem/Mead Technology Laboratories Gulf South Research Institute	Aroclor 1016 sometimes reported as 1242.
HERL-RTP	1 Chlorinated Dioxin/Soil/Soil, Sediment, Dust Samples	Wright State University	Sample specific to LC.[a]
EMSL-LV	3 Radionuclides/Water, Sand and Clay/Water, Soil, Sediment Samples	EMSL-LV	Sample specific to LC.[a] Only 1 radionuclide reported.

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[a] LC = Love Canal Study 1-619-026

EMSL-Las Vegas supplied two groups of PE samples to be used to evaluate soil and sediment analysis procedures. The samples were NBS River sediments spiked with organic compounds as noted in Table 4.4. These samples were analogous to the "double blinds" mentioned above and were treated in a similar manner.

Table 4.4 lists the PE samples used in the study and identifies:

- the providing EPA laboratory (sample source)
- the analytes contained (sample contents)
- the physical state of the sample (matrix)
- the types of collected samples audited by this sample (use)
- the subcontractor laboratories receiving each PE sample (laboratories receiving samples)

External QC Check Samples--

These samples were provided by several different EPA laboratories and one subcontractor as can be seen in Table 4.5. This table follows the format of Table 4.4 and includes a Comments section. The solutions were concentrates to be diluted as directed before analysis. The true values were known by GCA but not by the subcontractor laboratories. The providing EPA laboratories referred to these samples by different names (QA samples, QC check samples, QC samples) and the term External QC Check Samples is used to encompass all of these samples and distinguish them from internal QC samples whose true values were known to the subcontractor laboratories.

EPA's QA/QC planning for the Love Canal Study had not incorporated a complete series of QC samples whose true values were known to GCA. In response to GCA's request, EMSL-Cincinnati supplied large quantities of their QC Check Samples for water quality and drinking water analyses to supplement the QC samples which had been specifically designed for the study. This provided quickly available external QC Check Samples for almost all the classes of pollutants monitored at Love Canal. Some of the water quality and drinking water QC samples initially provided had been designed for use with different analytical methods (e.g., total phenols by colorimetry) with lower detection limits than the methods used on the Love Canal Study. This problem was discovered early on in the program and appropriate PE samples (Method 625 acid fraction) were substituted. Another problem was that, in general, these QC check samples were not available for shipment with the first batches of collected samples.

The External QC Check Samples were provided at the approximate rate of one QC sample for every twenty collected samples of similar type shipped to an analytical laboratory. Table 4.5 lists the sample contents, their use and the receiving laboratories. Results were included in the data base to enable rapid follow-up of any questionable results.

GCA staff reviewed all External QC Check Sample Results for reasonableness and checked all questionable results with individual laboratories. Reporting and calculation errors were found in this way, but very few problems with analytical techniques were uncovered. This correlates with the internal laboratory QC results which demonstrated good analytical performance by the subcontractor laboratories.

The Comments section of Table 4.5 indicates the experience with each sample during the study. The external QC Check samples specifically designed for the study were much more useful than the general use water quality and drinking water QC Check samples. The most frequent problems with the general use samples were that they were inappropriate for the Love Canal analysis procedures and that the samples were familiar to the analytical laboratories.

EPA Quality Control Audit on GC/MS and GC/ECD Data

In accordance with a request from the Love Canal Study Project Officer, GCA/Technology Division completed a limited study of mass spectral data from each of the laboratories performing organic analysis for the Love Canal Study. Since time and cost precluded extensive examination of all mass spectral data supplied, two analyses were selected from each laboratory for verification. Selection criteria for data to be verified was arbitrary but was influenced by several considerations, including:

- Levels of pollutants reported
- Number of compounds reported
- Toxicity of compounds reported

Using these criteria, two samples from each of the laboratories were chosen for examination. Included in this list were analyses representative of all sample types collected in the study.

The data was examined primarily to verify compound identifications. Quantitation of the substances found would have required data inputs not immediately available. The data required include such factors as:

- Amount of sample extracted
- Concentration volume of sample
- Internal standard spike level
- Instrument response factors
- Surrogate spiking levels

While this data can be made available through interpretation of laboratory notebooks, time constraints prohibited this process.

Upon completion of this task, a summary report, Verification of Selected Mass Spectral Data From the Love Canal Study, was submitted to the Office of Research and Development, U.S. EPA, Washington, D.C. in May, 1981.

Subsequent to this report, in June 1981, GCA was requested by EPA to copy a number of GC/MS data files on magnetic tape which had been submitted to GCA by the various analytical subcontractors. Approximately 150 sample files were requested with about 75 percent of these being soil and sediment samples. Affiliated blanks, standards and calibration runs brought to 300 the total number of files to be transmitted to EPA. These files were to be copied and sent to EPA in the following manner:

- All data on water samples was sent to EMSL-Cincinnati.
- All data on soil and sediment samples was sent to EMSL-Las Vegas.

GCA's role was complicated by the late arrival of tapes from some subcontractors, but eventually all GC/MS data due under the program was received on magnetic tape. Other problems included the inability of GCA to copy files on volatile organic analyses from Gulf South Research Institute due to format incompatibilities, lost data due to magnetic tape anomalies, and various computer difficulties. GCA supplied all taped information possible, as well as data on site locations, strata and analytical procedures.

In early August, 1981, GCA was informed that EPA was to screen all samples analyzed by Method 608-S (soils and sediments) for pesticides and PCBs in an attempt to determine the possibility of tetrachlorodibenzodioxin (TCDD) contamination. GCA was asked to submit all chromatograms of samples analyzed by this method with associated standard chromatograms. A total of 278 samples were analyzed via Method 608-S and all available chromatograms, with data report forms, were sent to EMSL-Las Vegas. GCA also checked into some problems and questions which EPA had discovered, such as the use of internal standards for identification and the lack of a DDT standard in PJB Laboratories standard solution.

In early December, 1981 GCA received from EMSL/LV a list of 49 samples for which no chromatographic tracings had been submitted to EPA under the audit. These are accounted for in the following manner:

Chromatograms sent to EMSL-LV but listed as missing	8
Radiation sample	1
Analyzed by EMSL-LV (no chromatogram received by GCA)	1
Semi-volatile sample (no GC/ECD analysis)	1
Non-valid sample number	2
Chromatograms not received by GCA from the subcontracting laboratories	36

Further checking on the 36 missing chromatograms indicated the number of missing samples from each laboratory was:

- Accurex--25
- Compuchem--1
- GRSI--1
- SWRI--7
- PJB--2

Each laboratory with missing chromatograms was contacted and all claimed that all documentation had already been sent to GCA. EMSL/LV was notified of this and no further action was taken by GCA.

Precision and Accuracy Estimates

The measures planned to enable the estimation of precision and accuracy included the collection and analysis of replicate samples and the analysis of well-characterized external QC check samples. Section 8.0 of the Love Canal Study QA Plan describes these measures in detail; they were used to provide estimates of:

- Intralaboratory measurement precision-based on the analysis of replicate field samples by each subcontractor laboratory.
- Intralaboratory precision for analysis only - based on the analysis of duplicate aliquots from one field sample by each subcontractor laboratory.
- Interlaboratory measurement precision - based on the analysis of replicate field samples by each subcontractor laboratory and an EPA referee laboratory.
- Accuracy for analysis only - based on the analysis of external QC check samples by each subcontractor laboratory.

All the planned measures were implemented with one exception. This involved the Tenax and foam air samples collected in duplicate sampling trains in the living areas of homes used as base sites in the residential air monitoring program. The plan was to estimate both intralaboratory and interlaboratory measurement precision from the analysis of these duplicates, using the sample splitting scheme described in Section 8.2.1 of the QA Plan. Pressures of time and difficulties of analysis prevented the complete implementation of the sample splitting scheme and only intralab measurement precision was estimated from these samples. Since two laboratories analyzed the Tenax samples and two different laboratories analyzed the foam samples, the estimation of interlaboratory precision was not as critical as when more laboratories were involved.

The computer reports described in the bullets above were prepared and submitted to EPA. Each printout included both a statistical report (mean difference, standard deviation, etc.) and an individual pairs listing which identified the samples statistically treated. The statistical report was classified by media, by pollutant and by laboratory so that it was easy to compare the performance of laboratories analyzing the same pollutant. The pairs listing was classified by lab, media and sample bank number, and pollutant.

The pairs listing gave the analytical result for each reported pollutant in each collected sample or external QC check sample and showed the wide range of reported concentrations for almost any pollutant in different collected samples. These varying concentration levels for one pollutant in one media were placed in one subgroup for statistical treatment. Defining several different concentration ranges for each pollutant and estimating precision or accuracy separately for each range would be helpful. However, so many pollutants were reported as trace or not detected that the total number of analytical results available for statistical treatment was small. Breaking these down into different concentration ranges would result in very small statistical subgroups and, therefore, was not done.

It was recognized that if concentration levels varied widely, precision estimates would suffer from the problem described above; it was thought that estimates of accuracy based on external QC samples would not. However, most external QC samples were provided at several different concentration levels and, therefore, shared the problem.

DATA MANAGEMENT SYSTEM

The purpose of the data management system was to collect and store all data generated as part of the Love Canal Study and to provide basic reports of the monitoring results. Table 4.6 lists the QA/QC measures employed on this program element.

Throughout the study, GCA's technical staff provided input to the Data Management staff; e.g., on design of the Sampling and Analytical Coding Manuals and Data Report forms, and were available for consultation on technical questions. The Data Management QC Coordinators' consulted with these in-house departments as necessary, and interacted with subcontractors on coding questions.

As noted in Table 4.6, the data reports were reviewed and checked at each stage in their processing by the Data Management staff and built-in computerized checks. Keypunching was machine-verified; questionable values were flagged on computer reports before they were sent to subcontractor labs for verification.

The thoroughness of the data review is demontrated in the remarkably error-free data set found in the Data Management System Audit. The audit report is included in Appendix A to this report.

TABLE 4.6. DATA MANAGEMENT QA/QC MEASURES

- Uniform Coding Standards
  - Individual coding manuals for sampling data and for analysis data
  - Individual coding forms for sampling data reporting and for analysis data reporting
- Log-in of all data forms sent to or from GCA/Technology Division
  - Forms traceable by serial number and/or sample ID number
- Review of Data
  - Check of coding forms by GCA for reasonableness before keypunch
  - Check of computer reports by GCA for reasonableness before sending to subcontractor lab for verification
  - Check of computer reports by each subcontractor lab to verify entries
  - Alert reports of concentrations exceeding alert levels
- Computer Card Preparation
  - Acceptable ranges of values supplied to keypunch operators
  - Key-verification of all cards
- Computer Check and Edit of Data
  - Edit check programs specific to sampling data, analysis data and verification action data
  - ID Cross-reference file to prevent double entries
  - Coordinates file - automated entry of sampling site coordinates
- Computer Program Safeguards
  - All programs tested with legal and illegal test data before actual data was processed.
  - "Levels" assigned to data files during program execution to prevent access by out of sequence programs
- Documentation of Changes to Data
  - Notations on coding forms by GCA staff
  - Notations on computer reports by GCA staff
  - Notations on computer reports by subcontractor labs
  - Notations in project workbooks by GCA staff
  - Verification action reports by GCA DMS staff

CORRECTIVE ACTION SYSTEM

Section 11.0 of the Love Canal QA Plan describes the closed-loop corrective action system followed by GCA during the study. The purpose of a closed-loop system is to ensure that any quality problem is reported to a person responsible for correcting it who is part of a system ensuring action and followup on all reported problems. Both immediate and long-term corrective actions are incorporated in the system.

Each subcontractor was required to include in his QA Project Plan:

- the named individual responsible for corrective action at each stage of his operations.
- Internal QC procedures which met or exceeded EPA's internal QC requirements and included control limits and corrective actions to be taken if these limits were exceeded.

Subcontractors were free to follow their own corrective action system as long as the stated requirements were met. Each subcontractor's project document inventory contains the documentation of corrective actions taken by that subcontractor. GCA did not monitor this documentation.

Summary tables of the EPA internal QC requirements are contained in Sections 6 and 7 of the Love Canal Study QA Plan. Each media sampled or analyzed is covered in a separate table and control limits and planned corrective actions are included. To ensure actual use by field and laboratory technicians, the Appendix A Sampling Procedures and Appendix B Analytical Procedures included the appropriate internal QC requirements.

Immediate Corrective Action

The control limits and planned corrective actions were provided to enable the uniform application of appropriate corrective actions as part of normal operating procedures. The actions taken were to be noted in field or laboratory notebooks but no other formal documentation was required. These on-the-spot corrective actions were an everyday part of the QA/QC system; they helped to avoid the collection of poor quality data.

Long-Term Corrective Action

GCA placed any problem not solved by immediate corrective action into the long-term category requiring appropriate documentation and followup. The initial record of the need for corrective action, the problem investigation, and the actions taken was made in the project workbook maintained by each GCA technical staff member.

GCA's routine policy is to initiate a Corrective Action (CA) Request Form for each long-term corrective action. The time pressures of the Love Canal Study caused these forms to be initiated after the fact in many cases, and not at all in some cases. However, workbook documentation was dated and complete and provided the action dates given on the CA Forms which were prepared by GCA. These forms are contained in Appendix C to this report; memos or letters which formed part of the corrective action are included to enable tracing the action.

DOCUMENT CONTROL/CHAIN-OF-CUSTODY PROCEDURES

The procedures used on the Love Canal Study were defined by the GCA QA Coordinator working with NEIC staff members, and following guidelines developed from:

- NEIC Policies and Procedures Manual, EPA-330/9-78-001R, Section II.
- Enforcement Considerations for Evaluations of Uncontrolled Hazardous Waste Disposal Sites by Contractors, NEIC, April 1980, Sections VIII and IX.

NEIC staff members reviewed the project-specific procedures and their comments were incorporated. GCA's QC Coordinators and QA Manager consulted with NEIC on any questions throughout the program.

A detailed writeup covering both document control and chain-of-custody procedures and requirements was provided to each subcontractor with his subcontract documents, or shortly thereafter. In addition, Appendix A to the QA Plan contains these procedures with special emphasis given to the sampling aspects; Appendix B contains a Document Control/Chain-of-Custody Section directed to the needs of analytical laboratories. Sections 4 and 5 in the overall QA Plan volume present the same information, addressing both the sampling and analysis requirements.

Document Control Procedures/Document Inventory

The purpose of document control is to ensure that all project documents will be accounted for and assembled into a document inventory when a project is completed; this facilitates tracing the history of the entire project or any part of it. The system implemented by GCA during the Love Canal Study was managed by Document Control Officers (DCOs) who were responsible for issuing, controlling and maintaining records of controlled documents.

GCA identified the principal items subject to document control, provided a project numbering system including individual subcontractor codes and provided serialized sample identification and custody forms.

GCA's DCO at the onsite Sample Bank maintained overall document control on all items related to sample collection and shipment. GCA's DCO at Bedford logged in all project documents, including data reporting forms, received at Bedford.

At the conclusion of project activity, each subcontractor was required to submit his complete project document inventory, classified according to the guidelines provided, to GCA for subsequent transferral to EPA. GCA has assembled these subcontractor document inventories at its Bedford headquarters; they will be submitted to EPA on request or at the conclusion of GCA's project activity.

Use of Project Notebooks--

GCA required that its own and subcontractor technical staff members maintain complete and traceable records of all project activity--in bound laboratory notebooks, when appropriate. The onsite Sample Bank DCO issued bound Field Data Sheets to the Sampling and Geotechnical subcontractors; Subcontractor and GCA/Bedford DCOs maintained control of notebooks issued to their staff. These notebooks form an important part of the project document inventory.

Chain-of-Custody Procedures

The purpose of chain-of-custody procedures is to document the identity of the sample, and its handling, from its first existence as a sample until information derived from it is introduced as evidence during an enforcement proceeding. Customized sample identification tags and custody records were provided by GCA to subcontractors and GCA's onsite Sample Bank directed chain-of-custody procedures and transferred custody of collected samples and QC samples to analytical laboratories. Each appropriate subcontractor was required to identify a Sample Custodian and to maintain document control of custody records.

MONITORING PROGRAM

GCA QA/QC SUMMARY REPORT

APPENDICES

APPENDIX A

AUDIT REPORTS

Page

Sampling Audit Reports A-3

Geotechnical Study Autid Reports A-35

Analytical Laboratory Audit Reports A-42

Data Management System Audit Reports A-58

Sampling Audit Reports

Page

Sampling Audit 20-22 August 1980 A-4

Overall Sampling Activities A-4

GCA Field Sampling Activities A-6

GTI Field Sampling Activities A-9

Sampling Audit 10-11 September 1980 A-13

Overall Sampling Activities A-13

GCA Field Sampling Activities A-20

GTI Sample Handling A-22

JRB Groundwater Sampling Activities A-25

Air Sampling Flow Audit 29 September - 1 October 1980 A-28

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To 1-619-026 File

Date 2 September 1980

From R. M. Ellersick

Subject QA Audit Love Canal Study: Overall Sampling Activities

An onsite system audit of sampling activities at Love Canal, Niagara Falls, N.Y. was conducted on 20-22 August 1980. The audit included the GCA Field Office and Sample Bank operations, the Geomet Technologies, Inc., (GTI) Field Office operation, and actual soil and air sample collection by GTI sampling crews. It was found that, despite serious and continuing problems, GCA and GTI staff at all levels were highly motivated to cooperate in achieving and completing a high quality sampling program.

The problems faced by both GCA and GTI field teams include the:

- Rapid startup required for the sampling effort.
- Special study inserted at the beginning of the project.
- Inability to follow the proposed sampling schedule because homes for air sampling were not available.
- Continual shifts in sampling schedules and priorities.
- Excessive work hours required to cope with the cited problems.
- Stress of working in a potentially hazardous environment.
- Usual startup problems in any field sampling effort.

The EPA, GCA and GTI project managers were onsite during the audit and have been almost continually since the sampling program started. Their presence enables the rapid resolution of questions and is a significant factor in overcoming the problems cited above, and in maintaining the morale of their staff under difficult conditions. The impact on quality caused by the continuing changes in media to be sampled and schedules to be followed was discussed with S. Bromberg on 20 August. He understands the problems caused by the frequent changes and is working toward a "normal" sampling schedule.

In light of the cited conditions, few quality problems have occurred. Those found during this audit were:

1. Sediment samples collected during the special TCDD study for priority pollutant analysis, including volatile organics, were collected in sample containers whose covers had not been oven-dried after methylene chloride rinsing. The containers had been prepared correctly for TCDD samples which only require air drying after methylene chloride rinsing; the priority pollutant sampling was an addition to the special study.

2. All samples collected through 21 August 1980, except water samples for volatile organics, were collected in sample containers with covers lined with adhesive-backed paper-reinforced teflon. This teflon lining material was supplied by EPA for use with the special study TCDD samples.

Corrective Action Relative to these Problems:

The samples involved have been identified and the laboratory results for them will be monitored to check on methylene chloride or general volatile organic contamination due to the cited problems. Blanks of the adhesive-backed teflon will be processed through the analytical method at GCA to determine contamination assignable to this cause. Corrective Action Forms have been initiated for each case by the QA Manager to ensure follow-up.

The remainder of this audit is written up in two separate sections so that it can be distributed to the audited subcontractor. As shown in the listed copies, all three audit sections will be distributed to EPA and GCA. GTI personnel will receive the "Overall Sampling Activities" and the "GTI Field Sampling Activities" sections.

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RoseMary Ellersick
QA Manager

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Date 2 September 1980

From R. M. Ellersick

Subject Q.A. Audit Love Canal Study: GCA Field Sampling Activities

An onsite system audit of GCA's sampling activities at Love Canal, Niagara Falls, N.Y. was conducted on 20-22 August 1980. This section of the audit report covers the Field Office and Sample Bank maintained onsite by GCA; each operation is described below. Recommendations for corrective action and a description of immediate corrective actions taken are included.

GCA Field Office

The Field Office is located in an unoccupied home on Colvin Boulevard near Love Canal; its facilities are well-suited to its use as an operations center. Three commercial and one FTS telephone line serve the office and standard office furniture has been installed to provide several small offices and larger areas where meetings can be held.

The Field Office was staffed by two experienced field samplers from GCA's Environmental Measurements Department. One of them had written much of the Sampling Procedures Manual for the study; both serve as GCA's onsite Sampling QC coordinators. It was apparent that Geomet was leaning heavily on the GCA Field Office staff for assistance of all kinds - technical questions on the sampling procedures, information on custody requirements, locating ventilating fans and other equipment, locating and picking up a utility map so that soil sampling could continue, etc. During a four hour period on 20 August and shorter periods on 21 and 22 August 1980, I observed the Field Office staff provide this assistance with the obvious goal of solving problems so that a successful sampling program results.

In addition, one of the GCA sampling QC coordinators has been observing all early sampling to:

- ensure that the appropriate sampling procedure is followed.
- answer questions concerning the procedure.
- determine if corrective action is needed.

The Field Office staff investigates questions concerning procedure changes and technical questions not covered in the procedures but no changes to procedures are made unless approved by R.M. Bradway, GCA's Project Manager and communicated by him to B. Mason, GTI's Project Manager, who must also approve the action.

The Field Office staff also operates the refrigerated truck which picks up collected samples at remote sampling points or at the Field Office, transferring sample custody from GTI to GCA at that time. The samples are delivered to the Sample Bank and, after proper documentation and packing, to Buffalo Airport in this truck.

In summary, the GCA Field Office Staff is highly motivated and has been providing invaluable assistance to the overall sampling effort.

Corrective Action Recommendations:

1. Clearer identification of people who should be contacted by the Field Office staff regarding technical questions.
2. More easily traceable documentation of changes.
3. Administrative/secretarial help for the Field Office staff.

Immediate corrective actions taken: (the numbers below correlate with the recommendations above).

1. Although the authority required for change was clearly defined, the pathway for investigating technical questions within EPA was not. This was discussed with S. Bromberg and R. Bradway and it was agreed that the Field Office staff should bring such technical questions to S. Bromberg who will pursue them. Other technical sampling questions are to be brought to R. Bradway.
2. The need for accurate and easily traceable documentation of changes was discussed with the Field Office staff who have been documenting changes in their project notebooks. One staff member suggested keeping a log book of procedural change requests and their resolution; this was implemented immediately. The person approving the change and the date of approval are included.
3. R. Bradway continued contacting employment agencies to achieve this.

GCA Sample Bank

The Sample Bank is located at the Bell Aerospace Wheatfield Plant about three miles from Love Canal and has physical facilities well-suited to project needs. They include two large laboratory rooms with adequate bench and hood space and a distilled, deionized water supply, a large storage area with a freezer and two small offices with a copier and standard office equipment.

The Sample Bank had been staffed by two experienced GCA technical staff members-a chemist and a geologist; a GCA environmental engineer arrived on 20 August to enlarge the permanent staff to three members. The Sample Bank Manager is familiar with the principles of Sample Bank operation and worked intensively with GCA's Sample Bank Manager and QA Manager on design of the Master Logs, the sample identification tags and the custody records for this program before leaving GCA's Bedford, Mass. location.

During a four hour period on 20 August and a shorter period on 21 August, I observed the Sample Bank in operation. Sediment and water samples were being packed during this time and staff members were working in a safe and efficient manner in handling both the sample packing and recording of sample data in the appropriate log. Depending on the nature of the samples (e.g. sediments shipped as "Poison B" have rigorous packaging requirements), one or two people worked on packing and another person recorded the sample information. The sample master logs were inspected and found to be complete and up-to-date; the staff obviously recognized the importance of careful and complete record keeping.

In addition to sample handling, the Sample Bank maintains document control over all sample-related documents such as sample tags, custody records, etc. It provides these documents to GTI and maintains traceability logs and document files on the premises. The Sample Bank also provides essential input to the data management system by encoding the sample data forms. The problems cited in the Overall Sampling Activities section of this audit had prevented the full implementation of this responsibility.

The Sample Bank staff was performing extremely well under difficult conditions and had properly assigned top priority to sample handling and documentation relating to these collected samples.

Corrective Action Recommendations:

1. Increased staff or clerical help for the Sample Bank.

Immediate Corrective Actions taken: (the number below correlates with the recommendation above).

1. This was discussed with R. Bradway and the Sample Bank Manager who took action on 21 and 22 August to hire a qualified college student.

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QA Manager

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To 1-619-026 File

Date 2 September 1980

From R. M. Ellersick

Subject QA Audit Love Canal Study: GTI Field Sampling Activities

An onsite system audit of GTI's sampling activities at Love Canal, Niagara Falls, N.Y. was conducted on 21-22 August 1980. This section of the audit report covers the Field Office maintained in North Tonawanda and actual soil sampling and air sampling. Each of these operations is described below; recommendations for corrective action and a description of immediate corrective actions taken are included.

GTI Field Office

The Field Office is located in two large connected storefronts approximately 10-15 miles from the Love Canal area. At the time of this audit, two secretaries and 10-15 technical staff members were using the facilities which consisted of one office and two completely open areas apportioned into functional work areas. One room was used principally for calibration and storage of air sampling equipment; the other was used for both office space and work areas. No laboratory facilities were available for sample container cleanup etc.; this was a serious deficiency.

A previous arrangement using Buffalo University laboratory space had proven unsatisfactory and on 22 August, GTI moved their sample container cleanup activities to one of the Sample Bank laboratory rooms leased by GCA, with the approval of senior GCA and GTI staff. Experience had shown this lab area was not needed for Sample Bank use and it corrected the GTI problem of not having laboratory facilities at their Field Office. This was an example of the excellent cooperation between GCA and GTI onsite. The Sample Bank laboratory room is closed off from the one to be used by GTI and will remain so to avoid contamination of collected samples.

Despite the rather poor Field Office facilities, the GTI technical staff seemed well-motivated and competent during the four hour period I spent at their Field Office on 21 August 1980. Two QA staff members were onsite working on document control procedures and writing up calibration procedures as they are developed by the technical staff.

Responsibility for calibration and maintenance of the air sampling equipment had been assigned; the responsible person was calibrating Dupont P4000 pump and an assistant was calibrating Dupont P125 pumps. The Calibration Manager seemed knowledgable and experienced and explained that he was not using the bubble meter supplied with the calibrators because it did not meet GTI's accuracy requirements. He was using different size burets for each model pump and was still working out the details of the best calibration procedure. The importance of the calibration function seems well recognized by GTI.

Managers of the various field operations brought questions to my attention in an obvious effort to conduct the sampling campaign properly. The staff members identified in GTI's QA Plan as responsible for each operation were onsite during my audit; they were participating in, and actively directing, preparations for sampling and actual sample collection. This was important since GTI has hired local college students to conduct much of the field sampling; audits of air and soil sampling showed the students to be performing well.

Corrective Action Recommendations:

1. Discontinue use of adhesive-backed teflon for lining sample container lids.
2. Better internal communication between GTI technical and QA personnel relative to technical questions, procedure changes, etc.
3. Better documentation of changes.

Immediate Corrective Actions Taken: (the numbers below correlate with the recommendations above).

1. EPA QA officers at Las Vegas and Cincinnati were contacted; they concurred that adhesive-backed teflon should not be used for this purpose.
2. GCA and GTI Project Managers and QA personnel discussed the importance of this issue.
3. It was agreed that GTI would maintain a log book of procedural change requests and their resolution, including the person approving the change and the date it was approved.

Soil Sample Collection

On 21 August 1980, I observed GTI personnel collecting soil samples at the 93rd St. school near Love Canal. A two-man Empire Soils truck crew operated the hydraulic-powered corer and a four-man GTI sampling crew removed the six-foot soil core from the metal corer, examined it carefully and noted its condition on field data sheets before transferring the sample to precleaned sample containers, or compositing it with other cores.

This was the second day of soil sampling and the GTI soil Field Coordinator was a member of the sampling crew. He directed the operation, examined and commented on the two-foot sections of each core, took custody of the samples and maintained the field log. The entire sampling crew, including the college or graduate students, seemed to be careful and conscientious in its work. Although the Sampling Procedures Manual was not available onsite, the Field Coordinator assured me that he was following it and that he briefed his crew before each sample collection trip.

The hydraulic corer collected a soil sample within 1-2 minutes but the handling of each six-foot core was tedious and rather lengthy. The change from ten cores to five cores collected at each sampling site seems a good one for this reason.

Corrective Action Recommendations:

1. Record the names of all sampling crew members in the field log.
2. Bring the Sampling Procedures Manual onsite.

Immediate Corrective Action: (number below correlates with recommendation above)

1. This was implemented immediately.
2. This will be done.

Air Sample Collection

On 22 August 1980 an audit of residential air sampling was conducted. This was the first air sampling day and five apartment units and one elderly housing unit were sampled; all were in Strata 2. The apartment units all had basements, a ground floor living area and an upstairs bedroom area; the elderly housing unit had a basement but no upstairs area. All these units had been ventilated the day before, following a written procedure supplied by GCA. Tripods to hold the air sampling pumps had been positioned in each unit and, after ventilation, the openings in each residence had been closed and sealed with evidence tape.

A five-man GTI crew, including the air Task Manager and the air Field Coordinator, actively participated in sample collection; a member of their QA staff observed. On entering a residence, the condition of the evidence tape was noted and recorded in the log; in no case had the evidence tape been disturbed.

The Tenax and polyurethane foam sampling trains were placed in close proximity, attached by clamps to the tripod. Teflon tubing was used to connect the exit end of the sampling tubes to teflon-tape covered tygon tubing connected to the sampling pump. Care was taken that the tygon tubing be kept away from the inlet ends of the samplers.

The sampling team was careful and conscientious but considerable improvement in efficiency is needed. Many small operational questions came up on this first air sampling effort. GTI senior staff started their intention of holding training sessions before the next air sampling day.

Corrective Action Recommendations:

1. Replace any windows that had been removed for initial ventilation, even if the window area has been boarded up.

2. Place evidence tape on the inside of the innermost window closures - usually the windows themselves.
3. Carry spares of all sampling equipment to the sites.
4. Carry field blanks to the sites and leave there during the sampling period.
5. Close basement doors before sampling begins.
6. Bring Sampling Procedures Manual in the sampling equipment truck.

Immediate Correction Actions Taken: (numbers below correlate with recommendations above).

1. This was implemented immediately.
2. This was implemented immediately.
3. This was discussed with GTI's technical and QA staff.
4. This was discussed with GTI's technical and QA staff. The QA staff did not have a good understanding of field blanks; a written clarification will be provided by GCA's QA Manager.
5. This was implemented immediately.
6. No immediate action was taken on this; it will be discussed with GTI QA staff relative to all sampling.

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QA Manager

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To 1-619-026 File

Date 9/19/80

From R.M. Ellersick

Subject QA Audit Love Canal Study: Overall Sampling Activities

An onsite audit was conducted on 10-11 September 1980 to check on general sample handling and follow-up on previous Corrective Action recommendations. Special attention was given to field blank use, sample container cleanup and preservation procedures. Groundwater sampling was also audited.

Although a 27 August 1980 Clarification of Sample Handling Procedures Memo had dealt with field blanks, some confusion obviously still existed. GTI personnel had prepared written container cleanup and preservation procedures for their staff but since JRB Associates, Inc. (JRB), the supervisory geologist subcontractor, was starting to collect groundwater samples in containers prepared for them by Advanced Environmental Systems, Inc. (AES), the importance of providing uniform information on field blanks, container cleanup and sample preservation was apparent.

Memos on field blanks and container cleanup were prepared onsite and hand-delivered to GCA, GTI, JRB and AES by the QA Manager on 11 September 1980. A memo on Preservation Requirements was prepared after checking the individual method recommendations and consulting with the EPA QA officers responsible for overall water, groundwater and dioxin QA. This memo was distributed to GCA, GTI, JRB and AES field personnel by the GCA Field Office Staff on 17 September. Further checking by Dr. William L. Budde of EMSL/Cinn, the laboratory responsible for overall water QA, has resulted in some revisions to the preservation memo. A revision to the field blank memo to include radioactivity samples was also required. The current, correct versions of these memos are attached to this audit report for distribution to the onsite field personnel as well as to the EPA QA officers.

On approximately 9 September, it was found that the Sample Bank water supply thought to be DDI water was a lesser quality, described by the AES laboratory president as pretreated distilled water. The AES laboratories are in the same building as the Sample Bank and have a true DDI water supply; this DDI water is now being used for field blanks. Samples of both water supplies have been sent to GCA labs for analysis; the GCA Sample Bank Manager is maintaining a log of possible quality problems which notes the date of changeover to the AES water supply for field blanks.

The remainder of this audit is written up in three sections covering GCA, GTI and JRB activities. Each subcontractor will receive the Overall Sampling Activities section and the audit of his own activities; EPA and GCA personnel will receive all sections. AES will receive an informational copy of the Overall Sampling Activities section.

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TO: GTI, JRB, AES, GCA Field Personnel
FROM: RoseMary Ellersick
SUBJECT: Clarification of Field Blanks
DATE: September 11, 1980, Revised September 15, 1980

The purpose of a field blank is to monitor sample handling procedures, including container cleanup, and document that contamination has not occurred. The field blank is to be carried to the sampling site, not exposed to the sampled air, water, soil, etc. but handled in the same way as collected samples. The field blank will remain in the refrigerated container (picnic cooler, etc.) used to transport collected samples while the sampling team collects its assigned samples.

The field blank is analyzed by the laboratory analyzing the samples, therefore, a field blank is required for each type of sample collected and for each media (air, water, soil, etc.) sampled. The following table should clarify this. Unless otherwise stated, the field blank is DDI water* in a clean sample container of the same type and size used for collected samples.

If the same team is sampling different types of waters, one field blank/sample type will be sufficient. If the same team is sampling different media, such as water and soil or water and sediment, or soil and sediment, field blanks for each sample type must be provided for each media.

FIELD BLANKS REQUIRED PER SAMPLING TEAM PER SAMPLING DAY

Air

Sample Type	Field Blank
Volatiles	Tenax Cartridge
Semivolatiles/Pesticides	Foam Plug Module

Water, Soil and Sediment

Sample Type

Volatiles
Semivolatiles
Pesticides
Nitrates, Fluorides
Metals
TCDD
TOC/TOX
Radioactivity - DDI water for water samples
- Empty container for soil/sediment samples.

*Use water from the Continental Treatment System in the AES laboratories.

RoseMary Ellersick

RoseMary Ellersick
QA Manager

cc: R. Bradway
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Date 19 September 1980

To R.M. Bradway

From R.M. Ellersick

Subject Preservation Requirements/Love Canal Study Samples LC 1-619-026

There will be no chemical preservation of air, soil, sediment or biota samples. Air, soil and sediment samples will be maintained at 4°C during all sample handling and shipping. Biota samples will be preserved by freezing.

Water samples will also be maintained at 4°C during all sample handling and shipping. Only drinking water samples will be treated for residual chlorine content. There will be no checking on chlorine content as samples are collected; the prescribed amount of sodium thiosulfate will be added to drinking water samples. These amounts are sufficient to destroy much more than the expected amounts of residual chlorine present in drinking water.

Revised Tables 1-3 list the required chemical preservation for water samples and suggest preservative concentrations to be used. Different concentrations may be used; the intent is to avoid the use of concentrated acids or bases in the field and to minimize the volume added to a sample. Concentrated sulfuric acid should always be added to water to avoid the splattering that may occur if water is added to the concentrated acid.

RoseMary Ellersick
RoseMary Ellersick
QA Manager

RME/cf

9/19/80

REVISED TABLE 1: DRINKING WATER SAMPLES ONLY

Sample Type	Preservative	Amount
Volatiles	2% $Na_2S_2O_3$	10 mg/vial = 0.5 ml
Semivolatiles	3.5% $Na_2S_2O_3$	35 mg/liter = 1 ml
Pesticides	10 N NaOH or 1:1H_2SO_4	pH 5-9
TCDD	10 N NaOH or 1:1H_2SO_4	pH 6-8
Metals	1:1 Ultrex HNO_3	pH less than 2
Nitrate/Fluoride	Conc. H_2SO_4	2 ml/liter
Radioactivity	None	

Record type of preservative and volume added on each sample tag.

TABLE 2: GROUNDWATER SAMPLES ONLY

Sample Type	Preservative	Amount
Volatiles	None	
Semivolatiles	None	
Pesticides	10 N NaOH or 1:1 H_2SO_4	pH 5-9
TCDD	10 N NaOH or 1:1 H_2SO_4	pH 6-8
Metals	1:1 Ultrex HNO_3	pH less than 2
Nitrate/Fluoride	Conc. H_2SO_4	2 ml/liter
Radioactivity	None	
TOC/TOX	None in field (analytical lab will preserve TOC aliquot)	

Record type of preservative and volume added on each sample tag.

9/19/80

REVISED TABLE 3: SUMP WATER, SEWER AND DRAIN WATER, SURFACE WATER SAMPLES

Sample Type	Preservative	Amount
Volatiles	None	
Semivolatiles	None	
Pesticides	10N NaOH or 1:1 H_2SO_4	pH 5-9
TCDD	10N NaOH or 1:1 H_2SO_4	pH 6-8
Metals	1:1 Ultrex HNO_3	pH less than 2
Nitrate/Fluoride	Conc. H_2SO_4	2 ml/liter
Radioactivity	None	

Record type of preservative and volume added on each sample tag.

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To 1-619-026 File

Date 9/17/80

From R.M. Ellersick

Subject QA Audit Love Canal Study: GCA Field Sampling Activities

GCA activities were not actively audited during this 10-11 September 1980 site visit. Previous corrective action recommendations were followed up and action to check on possible Sample Bank contamination was taken as described below.

Field Office

Corrective Action Follow-up - An administrative assistant has been hired completing recommendation 3 in my 2 September 1980 audit report. This person was working in the office during my visit and typed the memos distributed onsite.

Sample Bank

Corrective Action Follow-up - A part-time college student was hired to complete recommendation 1 in my 2 September audit report. This had not proved satisfactory and a full-time person was hired who was working on coding sample data forms during my audit.

Contamination Check - Since GTI's container cleanup takes place in a laboratory fully closed off from, but adjacent to, the Sample Bank it was felt appropriate to check on possible contamination caused by cleanup operations. This will be done by leaving a liter jar of Sample Bank water open to the Sample Bank air for an hour during the methylene chloride rinsing of sample containers in the GTI laboratory. At the end of this time, triplicate samples for volatile organics will be collected from both the exposed water and the same water from the tap; the six samples will be sent to GCA/Bedford for analysis. This experiment represents a worst-case situation since the only collected samples which are opened in Sample Bank handling are drinking water samples which are opened for a few minutes for compositing purposes.

In summary, all corrective actions recommended in my 2 September report have been implemented and both the Field office and Sample Bank staff continue to show great concern for achieving a high quality sampling program.

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QA Manager

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To 1-619-026 File

Date 9/17/80

From R.M. Ellersick

Subject QA Audit Love Canal Study: GTI Sample Handling

An onsite audit to check on sample container cleanup procedures, understanding of field blanks, and sample preservation procedures was conducted on 10-11 September 1980. Follow-up on previous corrective action recommendations was included.

Container Cleanup

The GTI container cleanup laboratory in the Bell Aerospace Wheatfield Plant was visited on 10 September 1980 and found to be an efficient operation in well-suited facilities with tap and pretreated distilled water, a hood and a large oven available. Written procedures for washing containers were being followed and the cleaned containers were being coded according to type and stored. The technician washing bottles seemed conscientious and aware of the importance of this task; she was working under the direction of GTI's Field Operations Scheduler who was present during the audit.

Some errors in the washing instructions were found and clarified with the Field Operations Scheduler (see Corrective Action Section). These errors involved preparation of metals containers and will be monitored by the field blanks handled in the same way.

Corrective Action Recommendations:

1. Do not rinse any containers for metals collection with methylene chloride.
2. Do rinse all containers for metals collection with diluted nitric acid as part of cleanup procedure.
3. List samples collected with improperly cleaned containers and date of changeover to cleaning procedures specified in 11 September 1980 memo.

Corrective Actions Taken: (the numbers below correlate with the recommendations above).

Immediate

1 and 2. Cleaning Procedures memo was prepared and distributed.

Longer-term

3. The GCA QA Manager will request that information from GTI and include it in a listing of possible quality problems.

Follow-up on Previous Corrective Action - Sheet teflon without adhesive backing was being cut to size to line sample container lids completing recommendation 1 in my 2 September GTI audit report.

Field Blanks

Some confusion on the required number of field blanks and their handling was evident from questions received by GCA Field Office personnel and the subject was discussed during a 10 September 1980 meeting of GTI/GCA Project Managers and senior field staff. In one case, field blanks had been carried by the sampling team but not submitted to GCA with the collected samples; a later attempt to submit them when they had been without refrigeration for a long period of time showed a lack of understanding or poor communication, or both.

Corrective Action Recommendations:

1. GCA QA Manager prepares a field blank clarification memo.
2. GTI improves internal communication.
3. GTI provides listing of samples collected without field blanks.

Corrective Actions Taken: (the numbers below correlate with the recommendations above).

Immediate

1. The clarification of Field Blanks memo was provided to GTI's Project Manager on 11 September. An error in the original - omitting Radioactivity from water, soil and sediment Sample Types - has been corrected in the copy attached to the "Overall Sampling Activities" section of this report.
2. GTI senior staff stated they will find ways to improve communication.

Longer-term

3. GCA QA Manager will request that listing and initiate a Corrective Action form to ensure follow-up.

Sample Preservation Procedures

There was no opportunity to observe preservation in the field during this audit but GTI's Water Task Manager provided me with a copy of the written procedures in use by GTI. No errors were found in these procedures based on the 3 December 1979 Federal Register. A Hellige field test kit was used to check residual chlorine content and determine the amount of sodium thiosulfate to add to samples. It was apparent that GTI was implementing sample preservation in a responsible way.

The 16 September 1980 Preservation Requirements memo supercedes GTI's written procedures and should be followed for uniformity in the sampling program.

RoseMary Ellersick
RoseMary Ellersick
QA Manager

RME/cf

cc:

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S. Black	R. Bradway	J. Brower
S. Bromberg	D. Cogley	B. Mason
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GCA Technology Division

Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To: 1-619-026 File

Date: 9/18/80

From: R.M. Ellersick

Subject: QA Audit Love Canal Study: JRB Groundwater Sampling Activities

Field Sampling

An onsite audit of JRB's groundwater sampling for Total Organic Carbon/Total Halogenated Organics (TOC/THO or TOX) was conducted on 10 September 1980 near Love Canal, Niagara Falls, N.Y. Measurements of pH and conductivity were made in the field by the two person sampling crew comprised of a geologist with an MS in Environmental Science and a BS Environmental Scientist. A third JRB staff member, a biologist, stated he was present to handle photography and QA/QC.

The sampling crew seemed conscientious but the overall operation was lengthy and inefficient, due in part to only one well being sampled at each site and, in larger measure, to the use of only one bailer. Three people were clearly not required to sample and photograph one well; cleaning the bailer after each use was time-consuming. The sampling was taking place the day after initial purging of the wells and the deep wells at each site were still dry. It was stated that another bailer was available but not being used until the design had been tested in the field. The design was quite simple: a narrow cylindrical teflon tube with a glass marble closure.

The pH meter was checked with a pH 7 buffer in the field; it was stated that a known conductivity solution was used to check the conductivity meter each sampling morning. No temperature readings were taken because the conductivity meter which had a built-in temperature reading was broken and no mercury thermometer was available. Care was taken to record sample information on tags and custody records and place collected samples in an ice chest promptly; field blanks were carried in the ice chest.

An earlier incident involving hexane rinsing of the bailer was attributed to incorrect information received from another subcontractor. The cleaning procedure in use for the bailer during the audit was correct although it seemed difficult to achieve adequate rinsing of the Alconox solution with the Sears sprayer being used. Blank samples were being taken to monitor the cleanup during my audit.

Corrective Action Recommendations:

1. Uniform information on sample handling should be provided by GCA to JRB.

2. Use a mercury thermometer to record temperature whenever pH and conductivity are measured.

3. Improve sampling efficiency by better sharing of duties by the sampling crew.

4. Maintain better documentation of photographs.

Corrective Actions Taken: (the numbers below correlate with the recommendations above).

Immediate and Short-term

1. The memos on field blanks and container cleanup were provided to the JRB Project Manager on 11 September. The preservation memo and a sample collection priority listing for low volume wells were provided on 17 September 1980.

2 & 3. These items were discussed with the sampling crew.

4. Marking the location on the back of each photograph and possible use of a Polaroid camera were mentioned to the photographer.

Field Office

A very brief stop was made at the JRB Field Office on 11 September to deliver the sample handling memos. The office is located in North Tonawanda, approximately 10-15 miles from the Love Canal area, in the same building as the GTI Field office.

The office area had formerly been used as a private club and one side of the very large room was occupied by a bar - unused during my visit. The only other furnishings were a few desks in the center of the room occupied by three senior JRB staff members and a secretary. I did not have sufficient time to explore the adequacy of the Field Office for its planned uses - certainly no container cleanup could have taken place there.

JRB's Project Manager mentioned a possible quality problem caused by volatile sample vials provided to JRB with the teflon lined septums inverted. I asked him to provide me with a list of sample numbers and the dates involved.

RoseMary Ellersick

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QA Manager

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UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

DATE	November 12, 1980
SUBJECT	Flow Audit at Love Canal
FROM	Bill Barnard, Physicist Bill Barnard PEB/QAD/EMSL, MD-77
TO	John C. Puzak, Chief PEB/QAD/EMSL, MD-77

On September 29-30 and October 1, a flow audit was performed on the pumps and hi-vols used by Geomet Technologies Inc. in the air sampling portion of the Love Canal Study. The two types of pumps used were the MESA Model P-125 and Model P-4000 made by E.I. duPont. These are small portable pumps designed to maintain their flows within ±5% with an input impedance ranging up to 635 mm of water. The Model P-125's were set to maintain flows in the 30 cc/min range for use with the Tenax samplers, while the P-4000's were set to maintain flows in the 1300 cc/min range for use with the pesticide samplers. The low flows were measured using a Type 5 laminar flow element (LFE) S/N 34662. A linear regression between this element and two NBS calibrated laminar flow elements, S/N 32222 and S/N 32223, produced the following data:

y intercept = -0.05568
slope = 1.00129
R^2 = .999998
Standard error of y intercept = .02405
Standard error of slope = .0002768

The high flows were audited using a Type 13 laminar flow element, S/N 27496, which was calibrated against the NBS standard S/N 32224. The results are below.

y intercept = -.10756
slope = 1.00006
R^2 = .999999
Standard error of y intercept = .36965
Standard error of slope = .000105

A problem arises in measuring the flows of these pumps with laminar flow elements. These flows are somewhat controlled by the pump speed and dependent on the input impedance to the pumps. At higher flows the piston moves faster producing short pulsations in the flow. At lower flows, especially near 30 cc/min, the piston moves rather slowly resulting in large flow pulsations. The short pulsations of the P-4000 pumps were nulled with a large volume installed in the pump line to act as a capacitor. These pulsations still produced a ±.3 mm water fluctuation across the LFE or an average manometer reading error of ±.7%. The large pulsations of the low flow pump at first produced unreadable results on the LFE manometer. It was necessary to use a restrictor and the large volume in conjunction to measure these flows. A needle valve acted as a restrictor to give a 160 mm pressure drop. The increase in resistance caused the pump to increase speed to maintain the same flow. The increase in speed created pulsations of shorter duration which allowed us to read the manometer much more accurately. The pulsations in the pressure drop across the LFE averaged ±.4 mm of water around the reading. This would account for an average manometer reading error of ±1%. The electronic manometer we used was calibrated against our lab water manometer which was certified by NBS. In the calibrations prior to the trip as well as the one immediately after the trip, there was less than .5% error in the comparison of the two manometers.

Geomet calibrated the P-125 pumps with 76 and 254 mm of water restriction. The P-4000 pumps were calibrated at 51 and 635 mm of water restriction. As sample restrictions were under 100 mm of water, Geomet averaged the initial and final flows at the lower restriction values.

We were able to audit 60 pumps Monday afternoon just prior to field sampling. The next day 16 pumps were audited at the first sample change at 6 a.m. At the 6 p.m. sample change, 16 pumps were audited, 8 of which had been audited at the 6 a.m. sample change. Tables 1 and 2 show the pump serial numbers and their flow values. The following day, October 1, 1980, 8 hi-vols were audited at the 6 a.m. sample and 19 P-125 pumps were reaudited after sampling. We audited 32 of the 92 P-125 pumps, and 36 of the 64 P-4000 pumps used in the double sample run on September 30, 1980.

The hi-vols at seven of the nine sites were audited. These audits were performed in the following manner.

1. The operator shut the hi-vol off to remove the filter cartridge.
2. The audit device, REF device no. 202, was used in conjunction with a clean filter rather than any of the pressure plates. This helped eliminate air flow problems associated with auditing flow controlled hi-vols.
3. The audit device was inserted and the hi-vol was restarted. The Dickson chart which had kept a record of the flow up to this time had been removed.
4. The hi-vol was again allowed to warm-up to a stable running condition, approximately 5 minutes.

5. A manometer reading was taken at this time, along with the ambient temperature.

Ideally the Dickson chart should have been left on the hi-vol until after the audit. This would have allowed us to get a better correlation between the audit value and the running value. However, since the hi-vol motor had been running for 24 hours and had only been off-line less than 5 minutes, the flows measured at the end of the warm-up period should be extremely close to those measured by the Dickson chart during the previous 24 hours.

Using the corrected equations given in the monitoring protocol text, the average of the differences and the upper and lower 95% probability limits are established

$$d_j = Y_j - X_j$$

where d_j = difference between Geomet's average flow value (Y_j) and the EPA average audit value (X_j)

$\bar{D}$ = the average of the differences

$$\bar{D} = \frac{1}{N} \sum_{j}^{N} d_j$$

where N = the number of pumps audited.

Upper 95% Probability Limit = $\bar{D}$ + 1.96 Sa

Lower 95% Probability Limit = $\bar{D}$ - 1.96 Sa

$$Sa = \left[\frac{1}{N-1}\left[\sum_{j=1}^{N} d_j^{2} - \frac{1}{N}\sum_{j=1}^{N} d_j^{\;2}\right]\right]^{1/2}$$

The average pump flows were compared and the final hi-vol flows were compared as shown in Tables 1, 2, and 3.

For the P-125 pumps (excluding pump 10688):

$\bar{D}$ = -0.584 cc/min

Upper 95% Probability Limit = 0.902 cc/min

Lower 95% Probability Limit = -2.070 cc/min

If the percent differences are used in the calculations, the results become:

$\bar{D}$ = -1.84%

Upper 95% Probability Limit = +3.1%

Lower 95% Probability Limit = -6.8%

For the P-4000 pumps (excluding pump 4780):

$\bar{D}$ = -56.1

Upper 95% Probability Limit = -8.61 cc/min

Lower 95% Probability Limit = -103.6 cc/min

If the percent differences are used in the calculations, the results become:

$\bar{D}$ = -4.15%

Upper 95% Probability Limit = -0.5%

Lower 95% Probability Limit = -7.8%

For the hi-vols (excluding hi-vol # 175697):

$\bar{D}$ = 2.20 ft^3/min

Upper 95% Probability Limit = 8.40 ft^3/min

Lower 95% Probability Limit = -4.00 ft^3/min

If the percent differences are used in the calculations, the results become:

$\bar{D}$ = 4.30%

Upper 95% Probability Limit = 16.6%

Lower 95% Probability Limit = -8.0%

Cooperation from Ben Mason and all the people at Geomet was excellent. Don Cade did a remarkable job of seeing that we got pumps to audit while he was in the middle of packing them up to start sampling at 6 p.m. Monday night; a very trying situation. The operation was well organized and the personnel were extremely cooperative.

cc: S.M. Bromberg, MD-75
G.G. Akland, MD-56
√R. Ellersick, GCA Corp.
GCA copy to R.M. Bradway

TABLE 1

Pump Flows
MESA Model P-125

Pump S/N	Geomet Calibration		Average Y_j	EPA Audit Values				Average X_j	$d_j = Y_j - X_j$	Percent Difference
	Before Sampling	After Sampling		Before Sampling	At 6am Sample Change	At 6pm Sample Change	After Sampling			
10076	30.0	30.2	30.10	30.5			30.4	30.45	-.35	-1.1
10164	29.8	32.1	30.95	30.9			32.4	31.65	-.70	-2.2
10174	29.7	31.4	30.55	28.8			29.8	29.30	1.25	4.3
10185	29.7	29.8	29.75	29.6			30.3	29.95	-.20	-0.7
10186	30.5	32.0	31.25	32.6			32.5	32.55	-1.30	-4.0
10192	30.1	29.3	29.70	29.9			29.7	29.80	-.10	-0.3
10601	30.0	29.8	29.90		31.1	31.0		31.05	-1.15	-3.7
10602	30.5	30.8	30.65	31.2			31.7	31.45	-.80	-2.5
10605	30.3	30.5	30.40	31.0			31.1	31.05	-.65	-2.1
10606	30.4	30.3	30.35		32.7	31.8		32.25	-1.90	-5.9
10607	29.6	29.9	29.75		31.2	31.4		31.30	-1.55	-5.0
10608	29.8	29.0	29.40	29.7			30.1	29.90	-.50	-1.7
10616	30.0	28.7	29.35	29.7			29.5	29.60	-.25	-0.8
10618	30.4	29.7	30.05	30.4			30.5	30.45	-.40	-1.3
10619	30.4	31.5	30.95		32.5	32.5		32.50	-1.55	-4.8
10621	30.0	28.4	29.20	30.0			29.4	29.70	-.50	-1.7
10626	30.5	29.9	30.20	30.5			30.7	30.60	-.40	-1.3
10633	30.2	28.2	29.20	29.5			29.5	29.50	-.30	-1.0
10641	30.7	29.4	30.05	30.9			30.2	30.55	-.50	-1.6
10652	28.9	27.7	28.30	25.9			27.2	26.55	1.75	+6.6
10654	30.0	28.4	29.20	30.1			29.5	29.80	-.60	-2.0
10655	29.3	28.1	28.70			29.2		29.20	-.50	-1.7
10657	31.2	29.8	30.50			30.9		30.90	-.40	-1.3
10658	30.8	29.9	30.35			30.8		30.80	-.45	-1.5
10660	29.8	29.4	29.60			30.8		30.80	-1.20	-3.9
10662	30.3	28.9	29.60	30.6			30.3	30.45	-.85	-2.8
10672	29.2	28.3	28.75	29.5			27.6	28.55	.20	+0.7
10685	30.1	29.4	29.75		31.6			31.60	-1.85	-5.9
10688	30.6	31.4	31.00		33.8			33.80	-2.80	-8.3
10689	30.4	28.8	29.6		30.5			30.50	-.90	-3.0
10691	30.5	28.2	29.35		30.5			30.50	-1.15	-3.8
10699	29.6	28.8	29.2	29.5				29.50	-.30	-1.0
							Mean %	Diff. =	-2.04 ±	2.75
					Without pump no. 10688		Mean %	Diff. =	-1.84 ±	2.54

Pump Flows
MESA Model P-4000

Pump S/N	Geomet Calibration			EPA Audit Values						
	Before Sampling	After Sampling	Average Y_j	Before Sampling	At 6am Sample Change	At 6pm Sample Change	After Sampling	Average X_j	$d_j = Y_j - X_j$	Percent Difference
4634	1319	1260	1289.5	1349				1349	-59.5	-4.4
4672	1280	1217	1248.5	1308				1308	-59.5	-4.5
4674	1307	1255	1281.0	1324				1324	-43.0	-3.2
4690	1316	1261	1288.5	1352	1360			1356	-67.5	-5.0
4695	1302	1266	1284.0	1349	1382			1366	-82.0	-6.0
4741	1263	1235	1249.0	1287				1287	-38.0	-3.0
4747	1308	1277	1292.5	1342				1342	-49.5	-3.7
4749	1354	1322	1338.0	1382				1382	-44.0	-3.2
4770	1330	1292	1311.0	1356				1356	-45.0	-3.3
4777	1276	1231	1253.5	1302	1344			1323	-69.5	-5.3
4780	1332	1037	1184.5	1654		1141		1398	-213.5	-15.3
4782	1288	1238	1263.0	1313				1313	-50.0	-3.8
4783	1271	1197	1234.0	1289				1289	-55.0	-4.3
4785	1281	1186	1233.5	1317				1317	-83.5	-6.3
4788	1338	1245	1291.5	1366		1327		1347	-55.5	-4.1
4793	1344	1308	1326.0	1389				1389	-63.0	-4.5
4801	1345	1290	1317.5	1396		1361		1379	-61.5	-4.5
4803	1337	1281	1309.0	1390		1404		1397	-88.0	-6.3
4815	1324	1288	1306.0	1344				1344	-38.0	-2.8
4816	1332	1336	1334.0	1372	1373	1367		1371	-37.0	-2.7
5116	1340	1295	1317.5	1371				1371	-53.5	-3.9
5138	1332	1314	1323.0	1380				1380	-57.0	-4.1
5156	1323	1270	1296.5	1441	1356	1376		1391	-94.5	-6.8
5157	1300	1196	1248.0	1199	1193	1197		1196	+52.0	+4.3
5158	1293	1249	1271.0	1316	1354			1335	-64.0	-4.8
5195	1328	1270	1299.0	1384	1358	1384		1375	-76.0	-5.5
5910	1261	1227	1244.0	1298				1298	-54.0	-4.2
5913	1303	1235	1269.0	1319				1319	-50.0	-3.8
5914	1295	1241	1268.0	1301				1301	-33.0	-2.5
5916	1313	1154	1233.5	1319				1319	-85.5	-6.5
5917	1323	1259	1291.0	1350				1350	-59.0	-4.4
5933	1299	1231	1265.0	1310				1310	-45.0	-3.4
5954	1286	1233	1259.5	1316				1316	-56.5	-4.3
5967	1353	1262	1307.5	1379				1379	-71.5	-5.2
5976	1324	1257	1290.5	1352				1352	-61.5	-4.5
5981	1276	1221	1248.5	1313				1313	-64.5	-4.9

Mean % diff. = -4.46 ± 2.59

Mean % diff.
without pump = -4.15 ± 1.8
no. 4780

TABLE 3

Hi-Vol Flows

Hi-vol EPA No.	Geomet Calibration After sampling	EPA Audit Values After sampling	$Y_j - X_j = d_j$	Percent Difference
178759	48.62	49.47	-.85	-1.7
040275	47.45	48.29	-.84	-1.7
175518	51.33	49.47	1.86	3.6
178764	53.78	51.47	2.31	4.5
175648	54.4	49.18	5.22	10.6
175698	45.93	47.65	-1.72	-3.6
153314	56.65	51.42	5.23	10.2
175697	65.9*	48.85	17.05	35.0
178761	57.84	51.42	6.42	12.5
	Avg. 53.54	Avg. 49.69	$\Sigma d_j =$ 34.68	

*Very erratic Dickson chart recording of flows during 24 hr. sampling period.

$\bar{D} = 1/n \; \Sigma d_j = 3.85$

$n = 9$

Mean of the % difference = 7.7 ± 11.80

Mean of the % difference
without hi-vol no. 175697= 4.30 ± 6.29

Geotechnical Study Audit Reports

Page

Sampling Audit 10-11 September 1980 A-25

JRB Groundwater Sampling Activities (in Sampling Audit Section) A-25

Geotechnical Study Audit 2-3 October 1980 A-36

Overall Geotechnical Activities A-36

JRB Supervisory Geologist Activities A-38

Technos Geophysical Measurements A-40

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To 1-619-026 File

Date 14 October 1980

From R. M. Ellersick

Subject QA Audit Love Canal Study: Overall Geotechnical Activities

An onsite system audit of geotechnical work at Love Canal, Niagara Falls, New York was conducted on 2-3 October 1980. The following firms are involved in this aspect of the Love Canal study:

JRB Associates, Inc.	Supervisory Geologist
Empire Soils Investigations, Inc.	Well Drilling
Technos, Inc.	Geophysical Surveys
GeoTrans, Inc.	Groundwater Modeling

This audit concentrated on the work of JRB and Technos although well drilling was in progress and the GeoTrans task leader responsible for analyzing and integrating new data into the predictive models was onsite during my visit. A chemist from EPA/ADA and GCA's technical director for this program area were also onsite.

The Empire Soils drilling crews observed were careful and conscientious in their work; the overall well drilling documentation maintained by JRB also showed this to be the case. Measurements of planar coordinates and ground elevation will be made by a surveyor under subcontract to Empire. Completed monitoring wells observed during audits of groundwater sampling were finished off neatly and had locking caps as required. Empire Soils appears to be providing high quality drilling services to this study.

Although GeoTrans active work in groundwater modeling won't start until all wells are drilled and measurements of formation permeability and groundwater elevations are made by JRB, their task leader was onsite for a geotechnical review meeting and to interact with the other geotechnical subcontractors. This enables GeoTrans to incorporate the most current data into their models and provide a quick turnaround when all data is available to them.

In summary, the overall geotechnical effort seemed to be going well. The subcontractors were working cooperatively with each other and maintaining the proposed schedule despite initial start-up problems.

The remainder of this audit is written up in two sections covering JRB and Technos activities and distributed to the audited subcontractor as well as to EPA and GCA personnel. The distribution of this Overall Geotechnical Activities audit is given below.

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To: 1-619-026 File

Date: 14 October 1980

From: R. M. Ellersick

Subject: QA Audit Love Canal Study: JRB Supervisory Geologist Activities

A system audit of JRB's work as supervisory geologist was conducted onsite on 3 October 1980 and focused on their efforts in these areas:

- documentation of drill site selection
- supervision of drilling, geologic logging and completion of monitoring wells
- hydrologic testing such as water table measurements, pump or slug tests
- collection of groundwater, sediment and rock core samples

Supervision and Documentation of Drilling Activities

A JRB supervisory geologist was onsite wherever drilling was in progress during this audit and an earlier 10 September 1980 audit. The geologists were ensuring that safety precautions were followed and maintaining field logs; they appeared uniformly conscientious about their work.

Inspection of the Well Logs on file at the GCA Field Office showed them to be complete and carefully documented. Several standardized forms were used for each well:

- A Site Sketch identifying utility locations and the measured location of the drill site.
- A Work Authorization form signed by the supervisory geologist and the drilling supervisor and approved by the project coordinator.
- A Well Log giving a profile soil core description and specific information on well diameter, depth, etc. The geologist and drillers and dates of work were listed.
- An As-Built drawing giving the construction profile of the well with materials used, depths and diameters.

Hydrologic Testing

The supervisory geologists interpret the split-spoon sediment samples at each monitoring well, take conductivity readings on the wash waters and make bucket and stopwatch flowrate measurements. At one deep (B) well a water table and flowrate measurement were performed as part of a 24 hour pump test; conductivity was also measured with a Beckman meter. These measurements were carefully taken and recorded despite a moderate rainfall.

At one deep bedrock well, the geologist was maintaining a very detailed log with frequent conductivity and flowmeter readings. Preparations were underway to do a packer test to establish the permeability of the bedrock at different levels within the well. Formation tests on these deep bedrock wells will supply information for the groundwater modeling work.

Groundwater Sampling

On 3 October 1980, I observed the same two-person sampling crew I had audited on 10 September 1980 collect groundwater samples for volatiles, semivolatiles, pesticides, fluorides/nitrates and metals. Although still only using one bailer, they worked efficiently and rapidly in collecting the multiple samples from each well. They checked pH by pouring the water over pH paper, added preservatives as required from dispensing pipet bottles and recorded these additions on the sample tags.

As on my earlier audit they were careful with chain-of-custody forms, and refrigerated the collected samples promptly. They carried field blanks and a spare bailer and the appropriate sections of the sampling procedures manual.

In summary, this audit showed the JRB staff members to be educationally qualified for their work responsibilities and to be careful and conscientious in carrying out these responsibilities.

RoseMary Ellersick

RoseMary Ellersick
QA Manager

RME/cf

cc: EPA
S. Black
S. Bromberg
W. Budde
R. Cosby
R. Harless
T. Hauser
J. Puzak
R. Watts

GCA
R. Bouchard
R. Bradway
D. Cogley
S. Diamond
A. Engelman
K. McGregor
P. McGlew
T. Porter
L. Seale
K. Wiltsee

JRB
L. Cerrillo
R. Colonna
D. Twedell

GCA Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To 1-619-026 File

Date: 14 October 1980

From R. M. Ellersick

Subject QA Audit Love Canal Study: Technos Geophysical Measurements

A system audit of Technos, Inc.'s geophysical survey activities was conducted on 2 October 1980 at the Technos field office in Niagara Falls, New York. The project manager and two staff members, a geochemist and a marine geologist, were present. Although the field office was located in a motel 10-15 miles from the Love Canal site and had minimal facilities, this did not appear to be hampering the operation. The instrumentation and associated calibration equipment was housed in a mobile van; the resistivity equipment used in Phase 1 was stored about 10-15 miles from Love Canal in Tonawanda, New York.

Planning for the next series of geophysical surveys was in progress during my audit so I did not observe any field measurements. However, I did check on the onsite calibration techniques used for the instruments in the van; these were in accord with the Technos QA Plan calibration writeups. The project manager reviewed with me the results of the Phase 1 effort which included:

- resistivity and magnetometer traverses along the length of Love Canal
- shallow and deep electromagnetic induction surveys
- ground penetrating radar survey
- seismic survey

Instrument charts and manual plots of the data on strata maps were available and the correlation between electromagnetic measurements and the magnetometer traverse along the Canal was pointed out by the geochemist who handles most of the electromagnetic work. He also does much of the computer processing of the raw data; this processing into two and three-dimensional contour plots aids in interpretation of the instrumental measurements.

The identification of data sheets, strip charts, etc. and their documentation in logbooks seemed carefully done. The data records included a sketch of the site surveyed with distances measured using a standard survey wheel and referenced to aerial photos or maps. Each instrument chart was numbered, dated, identified as to site location and initialed; at the end of each day or data set these charts were recorded in the logbook reserved for that instrument.

In summary, the Technos staff seemed knowledgeable and conscientious.

Corrective Action Recommendation:

1. The data sheets, strip charts, logbooks and any other project records should be identified with the project code (LC 1-619-026). It is not clear whether they also need serial numbering.

Short-term Corrective Action Taken:

1. The QA Manager checked with NEIC to determine if a need existed to serialize the instrument data sheets in the field. This is not necessary during their field use; they will be classified and numbered in sequence at the end of the project for inclusion in the document inventory.

RoseMary Ellersick
RoseMary Ellersick
QA Manager

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Technos
R. Benson
R. Glaccum

Analytical Laboratory Audit Reports

	Page
ERCO Site Visit 25 September 1980	A-43
AES Site Visit 3 October 1980	A-44
AES Followup 21 October 1980	A-47
Battelle and PedCo Site Visits 7,8 October 1980	A-49
PJB Site Visit 17 October 1981	A-52

GCA Technology Division

[illegible]

To K.T. McGregor Date 9/26/80

From D.S. Chase

Subject VISIT TO ERCO WITH TOM HINNERS

On September 25, 1980, Tom Hinners and I visited ERCO for a Love Canal lab inspection. Tom offerred them advice as to a proper chain-of-custody for the samples. Tom came up with several ideas as to locking the samples up when someone leaves the laboratory. Tom and I then spent several hours talking to John Mancy concerning several problems with the Love Canal samples. These problems are listed below:

a. They have no way to report a detection limit. Where should they report the detection limit on the data sheet?

b. Cu was omitted on the Required Spiking Concentration table and in the minimum analyses for laboratory control standards and control limits table.

c. They are quite restricted by the sample volume. They need at least a liter.

d. They had trouble with the following Hg samples. (Barbara has already spoken with them concerning the problem). They are interested in seeing if any splits or duplicates were analyzed by anyone else. The following samples were a problem:

W20052
W20065
W20150
W20056
W20054
W20073
W20058

The tour seemed to go quite well, and Tom was satisfied with what he encountered during his inspection.

DSC:vmk

cc: Love Canal File (ERCO)
R. Bradway
R.M. Ellersick
B.M. Myatt

GCA Technology Division

213 Burlington Road
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To 1-619-026 File

Date 15 October 1980

From R. M. Ellersick

Subject QA Audit Love Canal Study -
Advanced Environmental Systems Laboratory

A site visit to AES Laboratories in the Bell Aerospace wheatfield Plant at Niagara Falls, New York was made on 3 October 1980 to audit internal QC procedures for TOC, TOX, pH and conductivity measurements on groundwater samples.

TOC

The first Love Canal samples received by AES were analyzed on 10 and 13 September 1980, using an Oceanography TOC Analyzer Model 525. It was stated that the single value recorded in the laboratory notebook was the average of several injections of each sample. An EPA known value QC sample was run with each batch of 10-15 collected samples; the QC sample results were acceptable. However, laboratory personnel felt that this instrument was not too stable.

Two other Oceanography TOC Analyzers - Model 524 and Model 600 were evaluated at AES and samples received at the laboratory on 20 September 1980 and thereafter were analyzed on the Model 600 by direct injection. Duplicate injections were recorded for each sample and standard, and known value EPA QC samples were run with good results.

TOX

A Dohrmann DX 20 TOX Analyzer was used to determine total organic halides in Love Canal Samples. A single-point standard was used and a control chart maintained on percent recovery of the standard; the mean value was 89.5%. Instrument blanks, reagent water blanks and duplicate sample aliquots were run with every batch of approximately ten samples.

pH

An Altex/Beckman Specific Ion Meter Model 5000 was used to measure pH; two known buffers were used to standardize the instrument. Approximately every tenth sample, one buffer was used to check the standardization and a duplicate sample aliquot was measured.

Conductivity

A Barnstead Conductivity Bridge Model 70C was used and a duplicate sample aliquot was measured approximately every tenth sample. However, the use of a known conductivity KCl solution to standardize the instrument was not documented before 27 September 1980.

AES was clearly making a responsible effort to perform adequate internal QC. However, in the first series of results on 37 samples reported on 15 September 1980, three samples with pHs ranging from 9.7 - 12.9 were reported to have conductivities of 2-15 micromhos/cm. Also, Love Canal samples analyzed on the Model 600 tended to have TOC values about one-tenth of those analyzed on the Model 525. However, none of the same samples were analyzed on both instruments.

Corrective Action Recommendations:

1. AES reanalyze two samples for pH, conductivity and TOC.
2. AES identify the instrument used for TOC analysis for each sample series.
3. AES use a TOX standard at a concentration level close to that of the samples analyzed.

Corrective Action Followup: (the numbers below correlate with the recommendations above)

1. On 14 October, I called AES to see if the requested reanalysis had been performed. pH had not been remeasured since the holding time had been far exceeded; conductivity had been. The new measurements were markedly different from the original results and the entire sample series was remeasured. The TOC results were checked on a Dohrman DC 80 demonstration instrument and showed reasonable agreement with the original results. AES plans to determine TOC on these samples on their Oceanography Model 524 and submit a written report giving the original and all remeasured sample results.
2. This recommendation was repeated with the added suggestion that a known value QC sample be run with each batch. AES has been routinely running EPA QC samples for TOC.
3. The QA Manager will check further on appropriate standardization of the TOX analyzer.

RoseMary Ellersick
RoseMary Ellersick
QA Manager

RME/cf

cc: EPA

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R. Harless
T. Hauser
J. Puzak
R. Watts

GCA

R. Bouchard
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AES

W. J. McDougall
R. Wojcik

GCA
Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To: 1-619-026 File

Date: 21 October 1980

From: R. M. Ellersick

Subject: QA Followup Love Canal Study -
Advanced Environmental Systems Laboratory

After the 3 October 1980 audit of AES Laboratory which is performing TOC, TOX, pH and conductivity measurements on groundwater samples, further investigation of questions relating to TOC and TOX analyses was conducted. EPA personnel experienced with these analyses and Dohrmann, the manufacturer of the TOX analyzer used, were consulted. The information gathered is presented here as recommendations for action by AES.

TOC

Samples should be preserved on receipt by the laboratory and analyzed within 24 hours if possible. If not preserved immediately, the time of preservation should be noted.

TOX Standardization Procedure

1. Use of one standard is acceptable, however, the concentration should be close to that of the samples. The percent recovery of the standard should be calculated and included in the data report.
2. The standard should be injected on the carbon column just like a sample.
3. Blanks should be run and standard and sample results corrected for the blank values.
4. Sample results should be corrected for the percent recovery achieved on a standard close to the concentration of the sample.

In verbally transmitting this information to AES, it was noted by their Laboratory Operations Manager that they had been analyzing TOC samples within 24 hours in most cases. They preserved TOC samples when they could not be run in this time frame.

Relative to TOX, the first three points are standard procedures at AES and all results will be corrected for the appropriate percent recovery. The results will be clearly marked to indicate the recovery correction and the standard concentration used and recovery achieved will be included in the data report. Prior to this date, AES had listed percent recovery of the standard but not corrected sample results.

RoseMary Ellersick

RoseMary Ellersick
QA Manager

RME/cf

cc:

EPA	GCA	AES
S. Black	R. Bouchard	W.J. McDougall
S. Bromberg	R. Bradway	R. Wojcik
W. Budde	D. Cogley	
R. Cosby	S. Diamond	
R. Harless	A. Engelman	
T. Hauser	K. McGregor	
J. Puzak	P. McGlew	
R. Watts	T. Porter	
	L. Seale	
	K. Wiltsee	

GCA Technology Division

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To K.T. McGregor
R.M. Ellersick

10/21/80

From N. Pangaro

Subject LAB AUDITS OF BATTELLE AND PEDCO

On Tuesday, October 7, 1980, and Wednesday, October 8, 1980, Joe Bumgarner and I visited the two laboratories performing analysis on the Love Canal Tenax samples, spending full days at both Pedco (10/7) in Cincinnati and Battelle (10/8) in Columbus, Ohio, for the purpose of a laboratory audit.

This report will focus on particular problems encountered by these laboratories and steps taken since to remedy these problems:

While at Pedco, we met with Greg Fusaro, who is in charge of organic analysis and Thomas Wagner, in charge of QC. In reviewing Pedco's QC data, there seemed to be no major problem in their analytical techniques. Minor problems, such as minor instrument variabilities were encountered, but judging from internal QC data, there are no problems of concern.

We reviewed the chain-of-custody procedures for this lab. Briefly, the samples are checked in by the sample bank manager, assigned Pedco I.D. numbers and placed in a refrigerator in a locked room with limited access. Samples are checked out one at a time and logs are kept of all sample movement.

Special attention was given to the technique used to spike the internal standard onto the sample tubes. A bottle of known volume is spiked with a known amount (measured with a syringe) of PFT and PFB and brought to 30°C in a water bath. Gas tight syringes are then used to spike a known amount of the bottle contents directly into the Tenax tubes. Data shows that the resulting peak areas from these spikes are within 10% of those provided in the QC sample for comparable concentrations. Battelle uses a similar technique for spiking samples with similar results.

While at Battelle, we met with the people in charge of the analysis, Bruce Hickey and Dennis Lin, as well as the QC administrator, Dick Heffilfinger, among others. Battelle's chain-of-custody procedure proved to be more rigorous than that of Pedco's, with all samples to be run on a given shift checked out of a locked refrigerator and stored in a locked box near the instrument.

Special concern was given to the QC data that Battelle had been submitting. However, the problem was traced to a leaky seal in the NuTech unit and since that had been resolved the data seems better (see accompanying tables). Further scrutiny of their QC data will be strictly maintained to assure continued quality of the data.

NP:vmk
Attachments

cc: G.T. Hunt
J. Bumgarner, EMSL/RTP

BATTELLE

MID-RANGE DATA

		PRE 9/25			POST 9/25		
COMPOUND	EXPECTED	$\overline{X}$	SD	% SD	$\overline{X}$	SD	% SD
Benzene	361	403	100	25	454	63	14
Carbon Tetrachloride	240	189	67	35	257	67	26
Toluene	380	553	199	36	361	153	42
Dibromoethane	255	312	61	20	276	54	20
Trichloroethylene	379	470	162	34	381	86	23
Dichlorobenzene	366	446	98	22	356	105	29
Chlorobenzene	346	418	72	17	354	62	18
o-Chlorotoluene	354	324	145	45	380	91	24
# Samples		8				8	

BATTELLE

LOW RANGE DATA

		PRE 9/25			POST 9/25		
COMPOUND	EXPECTED	$\bar{X}$	SD	% SD	$\bar{X}$	SD	% S
Benzene	225	293	62	21	282	30	11
Carbon Tetrachloride	150	162	40	25	165	45	27
Toluene	230	185	235	127	226	210	93
Dibromo-ethane	154	185	26	14	174	11	6
Tetrachloro-ethylene	237	505	251	50	346	227	66*
Chlorobenzene	209	271	62	23	214	9	4
Dichloro-benzene	183	247	75	30	158	13	8
o-Chloro-toluene	177	174	74	43	172	6	4
# Samples		6			4		

If value from 9/30 is rejected (Q=0.97) values are:

Tetrachloro-ethylene	237				233	7	3

GCA Technology Division

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To: K.T. McGregor
R.M. Bradway

Date: 10/21/80

From: G.T. Hunt

Subject: TRIP REPORT – AUDIT OF PJB LABORATORIES

A site visit to PJB Laboratories was conducted on Friday, October 17, 1980 under contract 1-619-026. This visit was prompted by suspect data points received from PJB the week of Monday, October 6, 1980. The site visit was conducted by Dr. K.T. McGregor, and G.T. Hunt from GCA/Technology Division and Drew Sauter from EPA/EMSL, Las Vegas, Nevada. Summarized below are the preliminary findings prompting this visit and the text and findings of the actual visit:

Preliminary Findings

PJB Laboratories of Pasadena, California, had submitted the results of 3 samples analyzed for semivolatile organics to GCA the week of 10/6/80 (samples #20174, #20177, #20181).

The surrogate recoveries for the 3 samples in question were quite variable with the recoveries for 2 of the 3 compounds recorded as 0% recovered in each case.

The total ion chromatograms (GC/MS) accompanying these samples were unclear and indicated a potential problem in GC/MS operation.

For a written summary of the events prior to the site visit of 10/17/80, see memo from G.T. Hunt to R.M. Bradway, K.T. McGregor, dated 10/9/80 (copy attached).

EMSL/Las Vegas EPA – 10/16/80

A meeting was held at EPA Las Vegas on the above date to discuss, among other things, what course of action should be implemented in the PJB incident. The following people were present at this meeting:

GCA/Technology Division....Dr. K.T. McGregor
Mr. G.T. Hunt

EPA/Las Vegas..............Dr. Stuart Black, Dr. Lou Williams,
Mr. Drew Sauter, Dr. Paul Mills

The following items and points were discussed:

- The surrogate recoveries for the 3 samples in question were unacceptable – general consensus.
- The results of the performance evaluation samples PJB had submitted for the volatiles and pesticides were acceptable – Stuart Black.

- There appeared to be a GC/MS injection problem as evidenced by the 3 chromatograms submitted by PJB - Drew Sauter.

- If we must take evasive action against PJB, how will we accomplish a timely redistribution of their sample load?

- How are we to treat the data already generated by PJB if their semivolatile data is questionable?

PJB Laboratories, Pasadena, California - 10/17/80

The text of the site visit conducted at PJB Laboratories is summarized below:

Present at the morning meeting were:

PJB Laboratories....Mr. Jeffries, Dr. Benhur
GCA/Technology......Dr. K.T. McGregor, Mr. G.T. Hunt
EPA/EMSL Las Vegas..Mr. Drew Sauter

- Dr. Benhur indicated that they were experiencing problems with the analysis of the acid fraction.

- Dr. Benhur indicated that they were experiencing a "learning curve" with respect to the semivolatiles analysis by capillary GC/MS.

- Mike Jeffries indicated that they had experienced a serious problem with instrument noise due to a faulty ground. This had prevented them from performing admirally on the capillary GC/MS analyses. He did indicate, however, that this problem had started in June of this year.

- A laboratory tour was conducted by Mr. Jeffries and Dr. Benhur.

- Mr. G.T. Hunt was taken through a typical analysis flow scheme from time of sample receipt to generation of data.

- Dr. K.T. McGregor discussed the present disposition and scheduling of samples with Dr. Benhur.

- Mr. Drew Sauter reviewed the operation of PJB's GC/MS facilities.

As a result of these discussions and my personal observations during the course of the day, the following comments are appropriate:

- PJB was definitely experiencing an GC/MS injector problem. They were sweeping the inlet for several minutes as opposed to the prescribed 30 sec interval - Drew Sauter.

- They were acquiring too much data from the capillary hookup thus overburdening their computer files - Drew Sauter.

- There was little evidence of quality control of laboratory analyses. There were no designated quality control personnel. Each segment of the laboratory was responsible for their own quality control - G.T. Hunt.

- There was little documentation of quality control data. What data there was. was unavailable as it was stored on magnetic tape cartridges - G.T. Hunt.

- Standards used for surrogate spiking were the same standards used to generate instrument calibration curves. This is an unacceptable situation as there are essentially no internal checks on the accuracy of the prepared standards - G.T. Hunt.

- Available semivolatile QC data further indicated significant and unacceptable losses of spiked components. Over half of the spiked compounds were >90% lost. This is far outside even the acceptance criteria of 50-120% recovery for spiked materials. However, due to the lack of adequate quality control data it was impossible to isolate the cause of these losses. They could be losing materials in either the sample preparation sequence or in the GC/MS quantitation - G.T. Hunt.

- Both Dr. Benhur and Mr. Jeffries were quite unfamiliar with organic analysis in general and more specifically with GC/MS analyses. This appears to be a contributing factor to overall poor data quality.

- An audit of their pesticide analyses including available quality control data was satisfactory. The analyst in charge was quite competent and his records were in order. Internal quality control on these procedures indicated overall recoveries for spiked pesticides typically in the range of 80-100%. Both gas chromatographic techniques and Florisil column separations were also acceptable. I see no serious problem with their Method 608 pesticides analyses.

- An audit of their volatiles (Method 624) analyses also proved satisfactory. Both instrument operators were quite competent. Total ion chromatograms of laboratory control standards were acceptable. Volatile gases were also detected using this standard technique. Again, there was no available hardcopy documentation of laboratory quality control. All QC data requested was unavailable, since it was on magnetic tape. This again is a problem typical to the PJB Laboratory operation.

Comments and suggestions on the audit relayed verbally to PJB that afternoon are summarized below:

- The pesticide and volatiles analyses are acceptable.

- The semivolatiles analysis data are unacceptable due to inadequate and poor quality control data.

- PJB was instructed to send 1/2 of each semivolatile extract to GCA for subsequent disposition and analyses.

- PJB was instructed to re-run each of the 75 semivolatile sample extracts after first demonstrating acceptable performance on quality control samples.

- PJB would not receive any further samples until this matter has been rectified.
- PJB was instructed to isolate the problem causing the poor recoveries on laboratory control standards. It was suggested they use a GC/FID technique for confirmation of their sample preparation scheme.

GTH:vmk
Attachment

cc: R.M. Ellersick ✓
B.M. Myatt

GCA Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To: R.M. Bradway, K.T. McGregor

Date: 10/9/80

From: G.T. Hunt GTH

Subject: PJB DATA PACKAGE

Dr. Drew Sauter (EMSL/Las Vegas) called on 10/7 to inquire about the recent data package from PJB (#23). His comments are summarized below:

- The total ion chromatogram for the three semi-volatiles samples appear to be very clean.
- The background profile appears to be very high, however, which could cause serious problems in component identification.
- No semi-volatile species are detect in the samples in question.
- The letter accompanying the data submittal is poorly written and technically suspect.
- Dr. Sauter suggested that PJB was having a potential problem with their capillary inlet system.
- He hoped that we had already looked into the suspect data problem.
- He further recommended that we send no further samples to PJB until this matter is resolved.

I proceeded to review the data package in question and noted the following:

- The surrogate compounds in each of the samples in question (W20177, W20181, W20174) were undetected. Anticipated concentrations were 25 μg/ℓ but were observed as 0 μg/ℓ.
- The total ion chromatogram backgrounds in several instances were quite high making compound identification difficult.
- The letter accompanying the data package was unclear. The English was not perfect, but still understandable, however.

I called Drew Sauter back and indicated that we are indeed reviewing this data and were presently investigating the matter.

I called Robert Bradway and informed him of what had happened to this point and he indicated that Rosemary Ellersick and myself call PJB to investigate.

We did so on 10/8/80, in the afternoon. Summarized on the next page are my notes from this conversation with Dr. Benhur of PJB:

- He indicated that he experienced problems with the surrogates suggested for these samples. He, however, felt this was a problem inherent to the surrogates chosen.

- He indicated this his internal QC was fine. He, however, did not have any of this data available. He would get it to us, however.

- He noted that due to the complexity of the samples they were having problems finding the necessary ions to identify the semi-volatile species.

- He indicated that several people on his staff had experience with capillary columns and were instructing the others.

- He further indicated that his analytical detection limits were typically the order of 2-3 ug/ℓ.

- He would be interested in obtaining surrogate recoveries from other laboratories.

Based on my personal observations of the data and the above conversation I would like to make the following points:

- The reported surrogate recoveries are unacceptable for each of the three samples noted earlier.

- The detection limits quoted by PJB are not consistent with their other comments, e.g., if they could see 2-3 μg/ℓ why couldn't they detect even a 10% recovery of the surrogates (10% of 25 μg/ℓ).

- I am disturbed by Dr. Benhur's comment that they couldn't find the necessary ions to identify the said components.

- I am also disturbed by the comment concerning the complexity of each sample, yet the total ion chromatogram being relatively clean.

- I believe this matter warrants further investigation. Surrogate recovery data should be obtained from other contractors for comparison to PJB's results.

GTH:vmk
cc: B.M. Myatt
R.M. Ellersick

Page

Data Management System Audit Report A-59

Data Management Audit 27 April, 4-22 May 1981 A-62

GCA

GCA CORPORATION
Technology Division

213 Burlington Road
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Telephone 617-275-5444
Telex 92-3339

July 2, 1981

Mr. Steven Bromberg (MD-75)
Environmental Monitoring Systems Laboratory
U.S. EPA
Research Triangle Park, NC 27711

Dear Steve:

This package contains the results of the audit of the GCA Data Management System for the Love Canal Study (LC 1-619-026). The following are enclosed:

- The audit report by Eileen Conley who conducted the audit.
- The forms used in the audit (contained in the report appendix).
- A review of the audit results by Mary Havelock.

As you and I discussed earlier, the purposes of the audit were to check the raw data against the verified or validated data file to establish the error rate due to data processing and, if possible, to determine the difference in error rate between laboratories who were verifying data and those who were not. The GCA Sample Bank was considered as another laboratory for the purposes of the audit and approximately one percent of the total samples processed during the study were audited.

At my request, Mary Havelock designed the forms to be used in conducting the audit and instructed the auditor, Eileen Conley, in their use. Thereafter, Eileen operated independently; her report shows her good understanding of the audit and the audit logs show her thoroughness. I asked Mary Havelock to review the audit results giving special attention to the differences between laboratories who were verifying data and those who were not. As Table 3 in her report shows, no significant difference attributable to this factor was found.

I believe the extreme care used by GCA's data management group in checking on all questionable entries before keypunch, machine-verifying all keypunch entries and questioning changes made during the verification process produced the remarkably error-free data set shown in the audit. However, this also tended to blur the distinction that may have existed between verifying

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and non-verifying labs. I'm sure you'll agree that the achievement of an accurate data base was a far more important objective.

Let me know of any questions you have related to the audit.

Sincerely,

Rose Mary Ellersick

RoseMary Ellersick
QA Manager

RME/cf

cc: R.M. Bradway
E.E. Conley
M.C. Havelock
L.M. Seale (w/o Enclosures)

GCA Technology Division

Burlington Road
Bedford, Mass. 01730
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To Rosemary Ellersick, Mary Havelock

Date: 1 June 1981

From Eileen Conley

Subject: Love Canal Study Data Audit

Attached is the report of my findings for the audit of the Love Canal Study Data Audit. A summary of not only the results of the audit, but also the problems encountered is given in the text. The actual audit log sheets are in the Appendix.

If you have any questions, please call me.

Eileen E Conley

Eileen E. Conley

cc. Robert Bradway

LOVE CANAL STUDY

DATA AUDIT

Purpose

An audit was performed on a representative sample of the data that were collected for the Love Canal Study performed by GCA/Technology Division for the U.S. Environmental Protection Agency (EPA). The purpose of the audit was to assess the performance of GCA's Data Management Department in handling the large quantity of data generated for this study. In order that the audit be unbiased, it was performed by a technical staff member external to the Data Management Department and the Love Canal Study. The data examined were chosen to provide a selection of samples representative of both the sixteen subcontracting analysis laboratories hired to perform the analysis of the samples and the six sample medium groups analyzed (air, water, soil, sediment, biota, and quality control samples). Both sample data and analysis data were examined. In all, approximately .8 percent of the sample data and 1 percent of the analysis data were selected for the audit. Table 1 shows the number of audit samples selected by laboratory and medium group.

Method

The sample data were generated at the Love Canal site by the GCA Sample Bank staff. These data included information on the location, time, medium of each sample taken and the laboratory to which the sample was sent for analysis. This information was coded on sample data code sheets; each sheet contained information about one sample that was recorded on individual cards for storage in the computer.

The analysis data were generated by the subcontracting analysis laboratories. Each laboratory coded the results of the sample analyses on analysis code sheets and sent these to Data Management. One sample could have any number of coded sheets, depending upon the analyses performed on that sample. Each coded sheet contained information for up to 19 cards that would be entered into the computer. In the process of all this transfer of information, it was the task of Data Management to review the data, check it for consistency and insure that the data were properly entered into the computer. The data, as stored on the computer, were reviewed and verified by the labs and the Sample Bank as needed,and by EPA and the necessary changes were made. Any final changes from the labs, the Sample Bank or from EPA were made by Data Management during the subsequent data validation process.

The purpose of this audit was to determine how accurately the data were transfered, corrected and stored. Therefore, comparisons were made between the raw data, with any necessary changes, and the validated data as stored in the computer. For each sample, the original raw data coded sheets were located in the Data Management files and the contents of each card were compared to the contents of the validated card listing for that sample. Any discrepancies between the two were noted and the source of the discrepancy was sought. Authorization for the many changes made to the data during verification and validation could have come from the labs, the Sample Bank or the EPA and could have been received in writing, over the telephone or verbally. Notes of these changes were made on the raw data listings and in Data Management files. These notes were consulted to pinpoint the source of any discrepancy and, in most cases, the discrepancy was due to a correct change made to the data during verification or validation. If the source of the discrepancy was not found, a determination was made as to whether the change was a correct change or an incorrect change. Any unexplained changes or incorrect changes were noted. If any of the coded sheets were not found for a sample this was also noted. The audit log sheets are given in the Appendix.

Figure A-1 shows the Audit Log Sheets. These sheets simply tally the number of cards and coded sheets that exist for each sample, indicate how many sheets were found, and show if any discrepancy exists between the coded sheets and the validated card listing. Figure A-2 shows the Audit Discrepancy Log Sheets. Any discrepancy found and noted on the audit log can be further explained on these sheets. The determination is made as to whether the descrepancy represents a correct change or an incorrect change and the source of the change can be noted. If the discrepancy represents an incorrect change, this is considered to be a problem. Figure A-3 shows the Audit Problem Log. Information on the nature of the problem, the incorrect values and the correct values can be recorded here. Figure A-4 shows the Audit Log For Sheets Not Located. In some cases comment cards were added by Data Management during verification or validation of the data and no coded sheets exist for these cards. Distinctions are made on these log sheets between such added sheets and sheets that were not found and therefore are considered missing. Table 2 summarizes the statistics for the audit sample coded sheets not found for both the sample and analysis data. It was still possible to verify the data stored for the samples for which no coded sheets were found. Most of the data could be checked in log books that were kept by the Sample Bank staff. It was possible to verify the rest of the data by consulting Data Management files.

Results

The entire audit was dependent on the successful location of the coded sheets for each sample. In many cases, it was very difficult to locate these sheets in the files and in some cases, the sheets were not located at all. The laboratory for which it was most difficult to locate the coded sheets was Southwest Research Institute (SWRI). In the case of this lab, many of the sheets were not found in the proper file location but were found either misfiled or not filed and merely piled into miscellaneous packages of unfiled coded sheets. A logical explanation of this problem is the fact that a great deal of editing of SWRI coded sheets by Data Management was necessary. The frequent handling of the sheets could easily lead to misfiling.

Another lab for which it was difficult to locate the coded sheets was PJB/Jacobs Engineering Group, Inc. (PJB). For this lab, the coded sheets for a given sample were frequently separated in different packages in the files. This would be an indication that the lab did not send all the sheets for a given sample to Data Management at one time, but rather sent the various sheets for a sample at a number of different times. Although this resulted with more work in locating the sheets in the file, it cannot be said that the sheets were misfiled or misplaced by Data Management.

The only other labs that presented any difficulties in the location of the coded sheets were Gulf South Research Institute at Baton Rouge (GSLA) and Gulf South Research Institute at New Orleans (GSNO). GSNO is a subsidiary lab to GSLA. All samples were sent to GSLA from the Love Canal Site and some of those samples were then sent to GSNO for analysis. Coded sheets were sent either directly from GSNO or GSLA to Data Management or from GSNO back to GSLA and then to Data Management. It was therefore very difficult to keep the coded sheets for these two labs distinct. This resulted with understandable difficulties in locating the coded sheets for these labs.

For the most part, no significant trouble was encountered in locating the sheets for any of the other laboratories.

When the original coded sheets were compared to the validated card listing, any discrepancies were noted. As stated before, a great majority of the discrepancies were due to changes made to the data during verification and validation. Not one of these discrepancies was found to be a result of keypunch error. The only errors in the data that were found were incorrect changes to the raw data made by Data Management.

An incorrect change was considered to be one of two problems: 1) a change that made correct data on the coded sheets incorrect in the validated card list, or 2) a change that sould have been made during verification or validation and was either not made or was made incorrectly. Table 3 summarizes the problems that were identified for the sample data and the analysis data.

Conclusions

It is necessary to report the results of this audit in terms of samples, coded sheets and data cards. The reason for this is the fact that there is no correlation between the number of samples examined and the number of coded sheets or cards examined. This is due to the fact that each sample has any number of coded sheets and cards. To report the results for only one of these entities would mask the true results. The results of the audit, therefore, as shown in Table 3, are as follows: problems were identified in 2.3 percent of the samples examined. These problems existed on 1.2 percent of the coded sheets and 0.3 percent of the cards examined. Out of all the samples audited, coded sheets could not be found for 2.3 percent of the samples. This represents 0.9 percent of the coded sheets and .03 percent of the cards examined. A summary of the audit findings for each laboratory is given in Tables A-5 through A-8.

Figure A-1
LOVE CANAL STUDY
DATA MANAGEMENT SYSTEM
AUDIT LOG

Sample ID	Lab	Sample Date	Analysis Date	Dates to DM System	# Anal. Cards	Code Sheets Located		All Located (✓)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agreement (✓)	Discrepancy				
						Cards	Sheet		#CDS	#SHTS	#CDS	#SHTS		#Sheets OK	#Cards OK	#Sheets Not OK	#Cards Not OK	#Different Errors

Figure A-2
LOVE CANAL STUDY

DATA MANAGEMENT SYSTEM

AUDIT DISCREPANCY LOG

Sample ID	Lab	Change Submitted by Lab						Change By DM		Other Change:	#CDS	#SHTS	Correct Change		Incorrect Change		CannotTrace Change	
		Raw List		Other Written		Phone												
		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS				#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS

Figure A-3
LOVE CANAL STUDY
DATA MANAGEMENT SYSTEM
AUDIT PROBLEM LOG

Sample ID	Lab	Problem		Form No.	Poll/ Cas	Error Field	Value in DM	Correct Value	Comments
		Incorrect Change	Cannot Trace Change						

Figure A-4

LOVE CANAL STUDY

DATA MANAGEMENT SYSTEM

AUDIT LOG FOR CODE SHEETS NOT LOCATED

Sample ID	Lab	Date to DM	Card Type	Card Contents	Remarks	Added by DM (✓)	Sheet Missing (✓)

TABLE 1. AUDIT SAMPLE BREAKDOWN

	Air	Water	Biota	Sediment	Soil	QC	Total
ACEE		490 4		39 1	230 2	100 1	859 8
AES		230 1				35 1	265 2
BCL	1400 13					65 1	1465 14
CMTL		350 3		70 1	235 3	175 2	830 9
EMSC		130 1			35 1	40 1	205 3
EMSR	225 2					10	235 2
ERCO		700 8	5	25	135 1	100 1	965 10
GSLA	460 5	200 1		35 1	100 1	120 2	915 10
GSNO		135 2		30 1	90 1	90	345 4
ITT	9 1						9 1

(continued)

TABLE 1 (continued)

	Air	Water	Biota	Sediment	Soil	QC	Total
MWR1			165 / 2			71 / 1	236 / 3
PEDC	640 / 6					85 / 1	725 / 7
PJBL		580 / 7		30 / 1	60 / 1	125 / 1	795 / 10
SWRI	490 / 5	100 / 1	140 / 1	25 / 1	260 / 3	355 / 4	1370 / 14
TRW		160 / 2				30 / 1	190 / 3
WSU	7 /	35 / 1		50 /	23 /		115 / 1
Lab Totals	3231 / 32	3110 / 31	310 / 3	304 / 5	1168 / 13	1401 / 17	9524 / 101
Sample Bank	3090 / 26	3296 / 29	472 / 3	353 / 3	1503 / 10		8714 / 71

Each box entry = Total Samples / Samples Audited

TABLE 2. AUDIT SAMPLE CODED SHEETS NOT FOUND

	Examined	Not Found	% of Audit Samples
Sample Data			
No. Samples	71	4	5.6
No. Coded Sheets	74	4	5.4
No. Cards	240	10	4.2
Analysis Data			
No. Samples	101	0	0
No. Coded Sheets	348	0	0
No. Cards	3211	0	0
Total			
No. Samples	172	4	2.3
No. Coded Sheets	422	4	0.9
No. Cards	3451	10	0.3

TABLE 3. PROBLEMS IDENTIFIED IN AUDIT SAMPLES

	# Problems	% of Audit Samples
Sample Data		
No. Samples	1	1.4
No. Coded Sheets	1	1.4
No. Cards	1	0.4
Analysis Data		
No. Samples	3	3.0
No. Coded Sheets	4	1.1
No. Cards	8	0.2
Total		
No. Samples	4	2.3
No. Coded Sheets	5	1.2
No. Cards	9	0.3

Love Canal Study Data Audit Report

Appendix

Table of Contents

Table	Title	Page
A-1	Audit Logs	A-75
A-2	Audit Discrepancy Logs	A-83
A-3	Audit Problem Logs	A-93
A-4	Audit Log for Code Sheets Not Located	A-95
A-5	Audit Log Summary	A-99
A-6	Audit Discrepancy Log Summary	A-100
A-7	Audit Problem Log Summary	A-103
A-8	Audit Log for Code Sheets Not Located Summary	A-104

TABLE A-1. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT LOG - SAMPLE CARDS ONLY

Sample ID	Lab	Sample Date	Pkg. #	Dates to DM System	# Anal. Cards	Code Sheets Located		All Located (X)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agreement (X)	Discrepancy				
						#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHT		# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Different Errors
A10047	SWRI	08/22/80	TR4E	304(10/30)	3	3	1	X						0	2	1	1	1
A10059	PEDC	08/22	TR4A	298(10/24)	5	5	1	X			2	1	X					
A10113	GSLA	08/30	TR3	298(10/24)	5	5	1	X			2	1	X					
A10155	BCL	08/30	TR3	298(10/24)	5	5	1	X					X					
A10289	BCL	09/08	TR4C	298(10/24)	7	5	1		2	1				0	3	1	2	2
A10444	GSLA	09/16	TR4B	298(10/24)	6	6	1	X					X					
A10456	PEDC	09/16	TR4E	304(10/30)	5	5	1	X			2	1	X					
A10498	BCL	09/16	TR4E	304(10/30)	6	6	1	X					X					
A10700	BCL	09/21	TR9	317(11/12)	4	4	1	X										
A11177	PEDC	09/30	TR12	317(11/12)	4	4	1	X					X					
A11209	BCL	09/30	TR12	317(11/12)	4	4	1	X					X					
A11635	EMSR	09/22	-	347(12/12)	6	6	1	X							4	1	2	2
A11947	GSLA	10/14	TR27B	333(11/28)	6	6	1	X					X					
A11985	BCL3	-	-	347(12/12)	3	3	1	X					X					
A12102	PEDC	10/17	-	354(12/19)	5	5	1	X					X					
A12132	BCL2	10/15	TR27B	340(12/5)	3	3	1	X					X					
A12299	SWR1	10/20	TR22	340(12/5)	4	4	1	X					X					
A12393	PEDC	10/20	TR27B	340(12/5)	4	4	1	X					X					
A12459	BCL2	-	TR33	354(12/19)	3	3	1	X					X					
A12463	BCL2	10/20	TR27B	354(12/19)	4	4	1	X					X					
A12513	BCL	10/20	TR27B	354(12/19)	5	5	1	X					X					
A12584	GSLA	*		347(12/12)	3				3	1					2			
A12590	IIT	-	-	376(1/10)	3	3	1	X					X					
A12709	BCL2	10/25	TR25B	347(12/12)	4	4	1	X					X					
A12801	SWR1	10/30	TR25A	340(12/5)	4	4	1	X					X					

*No coded sheets found. Validated list compared to log book and DM files.

(continued)

TABLE A-1 (continued) (Page 2 of 8) - SAMPLE CARDS ONLY

Sample ID	Lab	Sample Date	Pkg. #	Dates to DM System	# Anal. Cards	Code Sheets Located #CDS	Code Sheets Located #SHTS	All Located (X)	Code Sheets Not Located #CDS	Code Sheets Not Located #SHTS	Code Sheets Edited by DM #CDS	Code Sheets Edited by DM #SHT	Total Agreement (X)	Discrepancy # Sheets OK	Discrepancy # Cards OK	Discrepancy # Sheets Not OK	Discrepancy # Cards Not OK	Discrepancy # Different Errors
A13063	EMSR	*		354(12/19)	3				3	1			X					
W20069	PJBL	08/23	4A	298(10/24)	2	2	1	X						0	2	1	1	1
W20051	ERCO	08/22	TRMISC	282(10/8)	2	2	1	X						0	1	1	1	1
W20129	PJBL	08/26	9	280(10/6)	4	4	1	X						0	1	1	1	1
W20202	GSNO	09/3	9	289(10/15)	4	4	1	X						0	3	1	1	1
W20280	GSNO	09/3	107B	324(11/19)	4	4	1	X						0	3	1	1	1
W20318	EMSC	09/03	TR27A	340(12/5)	4	4	1	X					X					
W20320	AES	09/08	107B	340(12/5)	3	3	1	X					X					
W20341	PJBL	09/08	17	347(12/12)	2	2	1	X					X					
W20369	ERCO	09/09	17	317(11/12)	3	3	1	X						0	1	1	1	1
W20619	PJBL	09/17	36	311(11/6)	3	3	1	X					X					
W20860	ACEE	09/22	36	317(11/12)	3	3	1	X					X					
W21353	ACEE	10/03	78	333(11/28)	3	3	1	X					X					
W21417	PJBL	10/01	107B	324(11/19)	3	3	1	X					X					
W21482	ERCO	10/01	52B	347(12/12)	3	3	1	X					X					
W21527	GSLA	10/3	52B	340(12/5)	3	3	1	X					X					
W21835	CMTL	10/14	78	354(12/19)	3	3	1	X					X					
W21899	EMSC	10/15	TR7	333(11/28)	3	3	1	X					X					
W21903	ACEE	10/15	TR7	347(12/12)	3	3	1	X						0	2	1	1	1
W22105	TRW	10/18	107B	347(12/12)	2	2	1	X					X					
W22132	TRW	10/20	107B	354(12/19)	2	2	1	X										
W22189	WSV	10/13	107B	324(11/19)	3	3	1	X						0	1	1	1	1
W25012	CMTL	09/26	TR7	340(12/5)	3	3	1	X										
W25191	ERCO	09/30	107B	347(12/12)	3	3	1	X										
W25208	CMTL	10/2	78	354(12/19)	4	4	1	X					X					

*No coded sheets found. Validated list compared to log book and DM files.

(continued)

TABLE A-1 (continued) (Page 3 of 8) - SAMPLE CARDS ONLY

Sample ID	Lab	Sample Date	Pkg. #	Dates to DM System	# Anal. Cards	Code Sheets Located		All Loca-ted (X)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agree-ment (X)	Discrepancy				
						#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHT		# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Different Errors
W25322	PJBL	10/03	107B	347(12/12)	3	3	1	X										
W25644	ERCO	10/13	78	347(12/12)	3	3	1	X										
W25727	CMTL	10/15	107B	369(01/3)	3	3	1	X			1	1						
W25748	ERCO	10/15	TR7	347(12/12)	2	2	1	X					X					
W25962	AES	10/30	TR33	340(12/5)	4	4	1	X						0	2	1	2	1
B30141	MWRI	10/10	TR16C	347(12/12)	2	2	1	X						0	1	1	1	1
B30318	SWRI	10/14	TR16C	347(12/12)	3	3	1	X						0	1	1	1	1
B30453	MWRI	10/18	TRMISC	361/12/26)	2	2	1	X						0	1	1	1	1
S40022	ACEE	08/19	TRMISC	304(10/30)	3	3	1	X					X					
S40070	SWRI	08/22	3	280(10/6)	2	2	1	X						1	1	1	1	1
S40110	ERCO	08/19	TRMISC	282(10/8)	2	2	1	X					X					
S40564	GSND	10/1	78	347(12/12)	3	3	1	X					X					
S40934	GSLA	-	95A	346(12/5)	3	3	1	X					X					
S45003	CMTL	*		414(02/16)	2				2	1			X		2			
S45062	PJBL	10/2	107B	347(12/12)	2	2	1	X					X					
S45360	ACEF	*		340(12/5)	2				2	1					2			
S45397	CMTL	10/15	-	414(02/16)	3	3	1	X					X					
S45419	SWRI	10/16	95A	347(12/12)	3	3	1	X					X					
S50007	CMTL	08/11	1	289(10/14)	2	2	1	X						0	1	1	1	1
S50112	EMSV	08/8	TRMISC	430(03/7)	4	3	1		1	1								
S50310	ACEE	10/11	107B	340(12/5)	2	2	1	X						0	1	1	1	2

*No coded sheets located. Validated list compared to log book.

(continued)

TABLE A-1 (continued) (Page 4 of 8) - ANALYSIS CARDS ONLY

Sample ID	Lab	Pkg. #	Analysis Date	Dates to DM System	# Anal. Cards	Code Sheets Located		All Located (X)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agreement (X)	Discrepancy				
						#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHT		# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Different Errors
Q03017	GSLA	113	10/4	333(11/28)	10	10	2	X			1	1	X	2	10			
Q03134	GSLA	157,159	11/5	340(12/5)	25	25	2	X						0	0	2	25	1
A10444	GSLA	67	09/29	311(11/6)	19	19	2	X					X					
A11947	GSLA	165	11/13	340(12/5)	19	19	2	X					X					
A12584	GSLA	309	11/22	347(12/12)	25	25	3	X						2	24	1	1	1
W21527	GSLA	134	11/07	340(12/5)	26	26	3	X					X					
S40934	GSLA	159	11/13	340(12/5)	29	32	4	X						3	29	1	3	1
Q04537	MWRI	179A	11/03	347(12/12)	94	100	6	X			94	6		5	94	1	6	1
B30141	MWRI	179A	11/06	347(12/12)	95	101	7	X						6	95	1	6	1
B30453	MWRI	228	11/13	361(12/26)	95	101	7	X						6	95	1	6	1
Q02046	CMTL	200	11/06	354(12/19)	42	44	5	X						4	42	1	2	1
Q02086	CMTL	235	12/08	361(12/26)	7	7	2	X					X					
W21835	CMTL	193	10/29	354(12/19)	27	27	4	X					X					
W25012	CMTL	168	11/03	340(12/5)	26	26	2	X					X					
W25727	CMTL	MISC	12/03	369(01/3)	42	41	3		2	1				2	40	1	1	1
S45003	CMTL	336A	11/22	414(02/17)	71	70	5		1	1				3	69	1	1	1
S45397	CMTL	329	01/20	414(02/17)	43	43	4		1	1				4	43	1	1	1
S50007	CMTL	24A	09/15	289(10/15)	29	29	3	X	1	1	1	1	X	2	29			
Q05404	PJBL	23	10/5	298(10/24)	14	15	1	X							14	1	1	1
W20069	PJBL	178A	11/13	298(10/24)	154	344	24	X								12	172	6
W20341	PJBL	196A	11/24	347(12/12)	76	85	6	X						4	74	2	9	2
W20619	PJBL	62	09/26	311(11/6)	26	26	3	X					X					
W21417	PJBL	60	10/12	324)11/19)	43	45	5	X						4	43	1	2	2
W25322	PJBL	162A	11/13	347(12/12)	4	4	2	X					X					
S45062	PJBL		10/22	347(12/12)	21	21	2	X					X					

(continued)

TABLE A-1 (continued) (Page 5 of 8) - ANALYSIS CARDS ONLY

Sample ID	Lab	Pkg. #	Analysis Date	Dates to DM System	# Anal. Cards	Code Sheets Located		All Located (X)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agreement (X)	Discrepancy				
						#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHT		# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Different Errors
Q06115	SWRI	28	09/29	289(10/15)	7	7	1	X						0	6	1	1	1
Q06617	SWRI	145A	11/05	347(12/12)	39	40	3	X						2	39	1	1	1
A10047	SWRI	10	08/31	311(11/6)	24	23	2		1	1				1	22	1	1	1
A10249	SWRI	22	09/18	298(10/24)	20	20	2	X			20	2	X					
A12299	SWRI	145A	11/04	340(12/5)	20	20	2	X					X					
A12801	SWRI	145A	11/11	340(12/5)	20	20	2	X					X					
W22244	SWRI	226A, 194A	11/07	347(12/12)	9	8	2		1	1				2	8			
B30318	SWRI	226A	11/20	347(12/12)	16	16	2	X					X					
S40070	SWRI	10	09/03	280(10/6)	27	25	2		2	1				1	24	1	1	1
S45419	SWRI	194A,	11/20	347(12/12)	43	44	6	X								1	1	1
Q07033	PEDC	72A	10/14	333(11/28)	25	25	2	X					X					
A10059	PEDC	2	09/09	311(11/6)	25	25	3	X					X					
A10456	PEDC	39A	09/22	304(10/30)	25	25	3	X					X					
A11177	PEDC	84A	10/23	317(12/12)	24	24	2	X					X					
A12102	PEDC	147A	11/10	354(12/19)	26	26	2	X					X					
A12393	PEDC	154A	11/12	340(12/5)	26	26	2	X					X					
Q07637	EMSC	124	09/18	333(11/28)	1	1	1	X					X					
A11635	EMSR	227,312	12/03	354(12/19)	11	10	2		1	1				2	10			
A13076	EMSR	227,312	12/03	354(12/19	11	10	2		1	1				2	10			
W20318	EMSC	131	10/8	340(12/5)	26	27	2	X			26	2		26	1	1	1	1
A11985	BCL3	105	10/20	354(12/19)	7	8	1	X						0	6	1	2	2
A12590	IIT	EXTQC	11/12	376(01/10)	16	16	3	X			11	2	X					
W20202	GSNO	15,26	10/02	289(10/15)	42	44	5	X						4	42	1	2	2
W20280	GSNO	30	09/26	324(11/19)	169	165	13		6	1						6	76	4
S40564	GSNO	174	11/21	347(12/12)	48	47	5		1	1	2	1	X					

(continued)

TABLE A-1 (continued) (Page 6 of 8) - ANALYSIS CARDS ONLY

Sample ID	Lab	Pkg. #	Anal-ysis Date	Dates to DM System	# Anal. Cards	Code Sheets Located		All Loca-ted (X)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agree-ment (X)	Discrepancy				
						#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHT		# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Differ-ent Errors
Q00097	ACEE		11/22	347(12/12)	41	42	4	X						3	41	1	1	1
W20860	ACEE	90	10/21	317(11/12)	144	146	14	X			25	4		10	119	3	6	2
W21353	ACEE		10/14	333(11/28)	42	43	5	X						4	42	1	1	1
W21903	ACEE		11/19	347(12/12)	42	43	5	X						4	42	1	1	1
S45360	ACEE	MISC	11/12	340(12/5)	72	79	6	X			1	1		5	72	1	7	1
S50310	ACEE	MISC	11/06	340(12/5)	26	26	3	X					X					
Q01026	BCL		10/15	333(11/28)	24	24	2	X					X	2	24	0		
A10155	BCL	20	09/19	298(10/24)	24	25	2	X			2	1		1	23	1	1	1
A10289	BCL		09/22	304(10/30)	24	25	2	X						1	24	1	1	1
A10498	BCL		09/29	311(11/6)	24	25	2	X						1	24	1	1	1
A10700	BCL		10/05	317(11/12)	25	26	2	X						1	25	1	1	1
A11209	BCL		10/15	333(11/28)	24	25	2	X						1	24	1	1	1
A12132	BCL		10/31	340(12/5)	24	25	2	X						1	24	1	1	1
A12459	BCL2		11/03	354(12/19)	28	29	3	X						2	28	1	1	1
A12513	BCL		11/04	354(12/19)	24	25	2	X						1	24	1	1	1
A12709	BCL2		11/08	347(12/12)	24	25	2	X						1	24	1	1	1
Q01601	ERCO		11/25	340(12/5)	14	14	1	X					X					
W20051	ERCO		09/8	282(10/8)	5	4	2		1	1				2	4			
W20369	ERCO		10/10	317(11/12)	29	29	3	X			1	1	X	3	29			
W21482	ERCO		11/18	347(12/12)	5	5	3	X					X					
W25191	ERCO		11/18	347(12/12)	3	3	2	X					X					
W25644	ERCO	183	11/25	347(12/12)	3	3	2	X					X					
W25748	ERCO	183	11/25	347(12/12)	3	3	2	X					X					
S40110	ERCO	5	09/10	282(10/8)	15	15	2	X					X					

(continued)

TABLE A-1 (continued) (Page 7 of 8) - ANALYSIS CARDS ONLY

Sample ID	Lab	Sample Date	Pkg. #	Dates to DM System	# Anal. Cards	Code Sheets Located		All Loca-ted (X)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agree-ment (X)	Discrepancy				
						#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHT		# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Differ-ent Errors
Q06158	SWRI	11/07	145A	340(12/5)	19	19	2	X					X					
A11332	SWRI	10/15	77A	324(11/10)	20	20	2	X					X					
S45506	SWRI	11/09		340(12/5)	27	27	3	X					X					
Q08619	AES	10/31	AES	340(12/5)	1	1	1	X						0	0	1	1	1
Q09032	TRW	11/25	216	354(12/19)	73	81	5	X						3	73	2	9	2
A10109	GSLA	09/19	26	298(10/24)	19	19	2	X						1	1	1	18	1
A12858	GSLA	11/24	309	347(12/12)	19	19	2	X			1	1	X					
S50291	GSLA	11/17	159	340(12/5)	26	26	3	X			26	3	X					
A10289	BCL	09/22	31	304(10/30)	24	25	2	X						1	24	1	1	1
A10852	BCL2	10/10		324(11/10)	28	28	3	X					X					
A12046	BCL	10/29	149A	340(12/5)	24	25	2	X						1	24	1	1	1
A12780	PEDC	11/20	169B	347(12/12)	29	29	3						X					
W20063	PJBL	09/02	11	282(10/8)	26	25	2		1	1				2	25			
W21359	PJBL	10/16	365	435(03/10)	4	4	2	X					X					
S50300	PJBL	10/22	196A	289(10/15)	33	35	3	X			3	1		0	0	3	35	2
W21159	ACEE	10/24	101	324(11/10)	72	81	6	X			81	6		5	72	1	2	1
S45182	ACEE	11/04	MISC	340(12/5)	72	79	6	X			1	1				6	79	2
W21832	ERCO	11/25	183	347(12/12)	3	3	2	X					X					
S45081	EMSC	11/15	211	369(01/3)	71	78	5	X						4	70	1	6	1
W21165	ERCO	10/31	114	333(11/28)	3	3	2	X					X					
S50320	GSNO	-		414(02/17)	1				1	1								
S45557	CMTL	02/5	346	414(02/17)	52	54	5		1	1	54	5	X					

(continued)

TABLE A-1 (continued) (Page 8 of 8) - ANALYSIS CARDS ONLY

Sample ID	Lab	Pkg. #	Analysis Date	Dates to DM System	# Anal. Cards	Code Sheets Located		All Located (X)	Code Sheets Not Located		Code Sheets Edited by DM		Total Agreement (X)	Discrepancy				
						#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHT		# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Different Errors
W20320	AES	MISC	9/9-10/6	340(12/5)	4	4	4	X			3	3		3	3	1	1	1
W22105	TRW	197	11/18	347(12/12)	26	26	3	X					X					
W22132	TRW	197	11/18	354(12/19)	74	82	6	X						4	74	2	8	2
W22189	WSV		11/14	324(11/19)	1				1	1								
Q06246	SWRI	224A	11/07	354(12/19)	2	2	1	X						0	0	1	2	1

TABLE A-2. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT DISCREPANCY LOG - AUDIT DISCREPANCY - ANALYSIS CARDS ONLY

		Change Submitted by Lab											Correct Change		Incorrect Change		Cannot Trace Change	
		Raw List		Other Written		Phone		Change by DM										
Sample ID	Lab	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
Q06115	SWRI	1	1							Pollutant HO_2 entered double amount coded	1	1	1	1				
S40070	SWRI	1	1							Change made during verification	1	1	1	1				
Q06617	SWRI							1	1	V01 invalidated	1	1	1	1				
Q06246	SWRI	2	1							Medium changed from BLNK to RBW	2	1	2	1				
W20318	EMSC							1	1	Pollutant B39 invalidated	1	1	1	1				
A11985	BCL3							1	1	1. Pollutant H01 deleted	1	1	1	1				
								1	1	2. Expected concentration coded incorrectly	1 1	1 1	1 1	1 1				
W22132	TRW							6 2	1 1	1. B57-62 eliminated 2. B34 and B39 invalidated	6 2	1 1	6 2	1 1				
S45419	SWRI							1	1	Y01 invalidated	1	1	1	1				

(continued)

TABLE A-2 (continued) (Page 2 of 10) - ANALYSIS CARDS ONLY

Sample ID	Lab	Change Submitted by Lab						Change by DM		Other Change			Correct Change		Incorrect Change		Cannot Trace Change	
		Raw List		Other Written		Phone												
		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
Q00097	ACEE							1	1	V01 invalidated	1	1	1	1				
W20860	ACEE							4	2	1. Acid and base portions combined on internal QC sheets	4	2			4	2		
								2	1	2. B34 and B39 invalidated	2	1	2	1				
W21353	ACEE							1	1	V01 invalidated	1	1	1	1				
W21903	ACEE							1	1	V01 invalidated	1	1	1	1				
S45360	ACEE							7	1	B55 and 57-62 eliminated	7	1	7	1				
A10047	SWRI							1	1	F04 adjusted by factor of 2.5	1	1	1	1				
A10155	BCL							1	1	H01 deleted	1	1	1	1				
A10289	BCL							1	1	H01 deleted	1	1	1	1				

(continued)

TABLE A-2 (continued) (Page 3 of 10) - ANALYSIS CARDS ONLY

		Change Submitted by Lab																
		Raw List		Other Written		Phone		Change by DM					Correct Change		Incorrect Change		Cannot Trace Change	
Sample ID	Lab	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
W20202	GSNO							1	1	V01 invalidated	1	1	1	1				
W25644	ERCO							3	2	Cards entered twice & duplicate analyzed	3	2			3	2	3	2
Q03134	GSLA							25	2	Error in method code for each card	25	2	25	2			25	2
A12584	GSLA							1	1	Adjusted for by factor of 2.5	1	1	1	1				
Q04537	MWRI							6	1	B57-62 eliminated	6	1	6	1				
S40934	GSLA							3	1	Values not added on external QC code sheet	3	1			3	1	3	1
B30453	MWRI							6	1	Eliminated B57-62	6	1	6	1				
Q02046	CMTL							1	1	V01 invalidated	1	1	1	1				
								1	1	V13 eliminated	1	1	1	1				

(continued)

TABLE A-2 (continued) (Page 4 of 10) - ANALYSIS CARDS ONLY

Sample ID	Lab	Change Submitted by Lab						Change by DM		Other Change			Correct Change		Incorrect Change		Cannot Trace Change	
		Raw List		Other Written		Phone												
		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
S45003	CMTL							1	1	Pollutant card B39 invalidated	1	1	1	1				
S45397	CMTL							1	1	Pollutant cards V01, invalidated	1	1	1	1				
Q05404	PJBL							1	1	B52 invalidated	1	1	1	1				
W20341	PJBL							2	1	1. B34 and B39 invalidated	2	1	2	1				
								7	1	2. B55 and B57-62 eliminated	7	1	7	1				
W21417	PJBL							1	1	1. V01 invalidated	1	1	1	1				
								1	1	2. V13 eliminated	1	1	1	1				
W20320	AES			1	1					D02 changed from 2.8 to 3.4	1	1	1	1				
W20069	PJBL							77	6	1. Z W on PJBL samples	77	6	77	6				
								77	6	2. pw BW on w samples	77	6	77	6				
								77	6	3. DW cw on z samples	77	6	77	6				
								4	2	4. B34 and B39 invalidated	4	2	4	2				
		14	2					14	2	5. B55 and B56-72 eliminated	14	2	14	2				
								154	12	6. Analysis results replaced with report analysis	154	12	154	12				

(continued)

TABLE A-2 (continued) (Page 5 of 10) - ANALYSIS CARDS ONLY

Sample ID	Lab	Change Submitted by Lab: Raw List #CDS	Raw List #SHTS	Other Written #CDS	Other Written #SHTS	Phone #CDS	Phone #SHTS	Change by DM #CDS	Change by DM #SHTS	Other Change	#CDS	#SHTS	Correct Change #CDS	Correct Change #SHTS	Incorrect Change #CDS	Incorrect Change #SHTS	Cannot Trace Change #CDS	Cannot Trace Change #SHTS
A10498	BCL							1	1	H01 deleted	1	1	1	1				
A10700	BCL							1	1	H01 deleted	1	1	1	1				
A11209	BCL							1	1	H01 deleted	1	1	1	1				
A12132	BCL2							1	1	H01 deleted	1	1	1	1				
A12459	BCL2							1	1	H01 deleted	1	1	1	1				
W20280	GSNO							76	6	DW changed to cw	76	6	76	6				
								2	2	B34 invalidated	2	2	2	2				
		3	1					3	1	BN comment deleted by lab	3	1	3	1				
		3	1					3	1	Acid comment added by lab	3	1	3	1				
A12513	BC1							1	1	H01 deleted	1	1	1	1				
A12709	BCL2							1	1	H01 deleted	1	1	1	1				

(continued)

TABLE A-2 (continued) (Page 6 of 10) - ANALYSIS CARDS ONLY

Sample ID	Lab	Change Submitted by Lab						Change by DM		Other Change			Correct Change		Incorrect Change		Cannot Trace Change	
		Raw List		Other Written		Phone												
		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
A10289	BCL							1	1	H01 deleted	1	1	1	1				
Q09032	TRW							2	1	B34 and B39 invalidated	2	1	2	1				
								7	1	B57-62 eliminated	7	1	7	1				
A12046	BCL							1	1	H01 deleted	1	1	1	1				
S50300	PJBL							2	2	I03 and S85 invalidated	2	2	2	2				
								33	3	Medium field changed to S50	33	3	33	3				
W21159	ACEE							2	1	B34 and B39 invalidated	2	1	2	1				
A10109	GSLA							18	1	Method code correlated	18	1	18	1				
Q08619	AES							1	1	Surrogate field coded	1	1	1	1				

(continued)

TABLE A-2 (continued) (Page 7 of 10) - ANALYSIS CARDS ONLY

		Change Submitted by Lab																	
		Raw List		Other Written		Phone		Change by DM					Correct Change		Incorrect Change		Cannot Trace Change	
Sample ID	Lab	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
S45182	ACEE							72	6	BC CS	72	6	72	6				
								6	1	B57-62 eliminated	6	1	6	1				
S45081	EMSC							6	1	B57-62 eliminated	6	1	6	1				
W2527	CMTL							1	1	V01 invalidated	1	1	1	1				

(continued)

TABLE A-2 (continued) (Page 8 of 10) - SAMPLE CARDS ONLY

Sample ID	Lab	Change Submitted by Lab						Change by DM		Other Change			Correct Change		Incorrect Change		Cannot Trace Change	
		Raw List		Other Written		Phone												
		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
W20341	PJBL							1	1	Program change	1	1	1	1				
W20202	GSNO							1	1	Program change	1	1	1	1				
W20129	PJBL							1	1	Program change	1	1	1	1				
W20069	PJBL							1	1	Program change	1	1	1	1				
W20051	ERCO							1	1	Changed by special program to add type of analysis	1	1	1	1				
W25962	AES							2	1	Program changes corrected during raw data edit	1	1	1	1				
550310	ACEE							1	1	1. Composite/grab changed during raw data edit	1	1	1	1				
								1	1	2. Depth given by sample bank over phone	1	1	1	1				
B03141	MWRI							1	1	Coor. deriv. corrected during raw data edit	1	1	1	1				

(continued)

TABLE A-2 (continued) (Page 9 of 10) - SAMPLE CARDS ONLY

		Change Submitted by Lab																	
		Raw List		Other Written		Phone		Change by DM					Correct Change		Incorrect Change		Cannot Trace Change	
Sample ID	Lab	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
B30453	MWRI							1	1	Change in log book changed during raw data edit	1	1	1	1				
A10047	SWRI							1	1	Incorrect C. of C. furnished by sample bank	1	1			1	1		
S50007	CMTL							1	1	Program change	1	1	1	1				
S40070	SWRI							1	1	Program change	1	1	1	1				
A10289	BCL							1	1	Default values	1	1	1	1				
								1	1	Comment added to explain default	1	1	1	1				
A11635	EMSV							1	1	1. Program change corrected during raw data edit	1	1	1	1				
								1	1	2. Corrected during raw data edit	1	1	1	1				
W22132	TRW							1	1	Information in log book added after raw data edit	1	1	1	1				
W21899	EMSV							1	1	Information in log book added during raw data edit	1	1	1	1				

(continued)

TABLE A-2 (continued)   (Page 10 of 10) - SAMPLE CARDS ONLY

		Change Submitted by Lab																
		Raw List		Other Written		Phone		Change by DM					Correct Change		Incorrect Change		Cannot Trace Change	
Sample ID	Lab	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
B30318	SWR1							1	1	Coor. deriv. corrected during raw data edit	1	1	1	1				
A13063	EMSR							1	1	NOR EMSC during data edit	1	1	1	1				

TABLE A-3. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT PROBLEM LOG - SAMPLE CARDS ONLY

Sample ID	Lab	Problem: Incorrect Change	Problem: Cannot Trace Change	Form No.	Poll/Cas	Error Field	Value in DM	Correct Value	Comments
A10067	SWRI					C°C Prep to QC	6003	1502	Not a change: Sample bank furnished incorrect prep to QC over telephone

(continued)

TABLE A-3 (continued) (Page 2 of 2) - ANALYSIS CARDS ONLY

Sample ID	Lab	Problem: Incorrect Change	Problem: Cannot Trace Change	Form No.	Poll/ Cas	Error Field	Value in DM	Correct Value	Comments
W25644	ERCO			J08 J41	I15 I16				Cards entered twice
S40934	GSLA	X		J60	P10, P15, P17	Pollutant Card	Omitted	Obs. Conc. Exp. Conc. P10 2.12 2.77 P15 1.93 2.49 P17 1.68 2.26	
W20860	ACEE	X		J05	S32 S33	Pollutant Cards	Obs. Conc. Exp. Conc. 7 40 7 40	Obs. Conc. Exp. Conc. 7 20 7 20	Lab instructed to combine expected concentration for acids. Base fractions then instructed not to combine

TABLE A-4. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT LOG FOR CODE SHEETS NOT LOCATED - SAMPLE CARDS ONLY

Sample ID	Lab	Date to DM	Card Type	Card Contents	Remarks	Added by DM (X)	Sheet Missing (X)
A10289	BCL	298(10/24)	Sample (2)	Sample data		X	
A12584	GSLA	547(12/12)	Sample (3)	Sample data			X
A13063	EMSR	354(12/19)	Sample (3)	Sample data			X
S45003	CMTL	414(02/16)	Sample (2)	Sample data			X
S50112	EMSV	430(03/7)	Sample (1)	Sample data		X	
S45360	ACEE	340(12/5)	Sample (2)	Sample data			X

(continued)

TABLE A-4 (continued) (Page 2 of 4) - ANALYSIS CARDS ONLY

Sample ID	Lab	Date to DM	Card Type	Card Contents	Remarks	Added by DM (X)	Sheet Missing (X)
W22244	SWRI	347(12/12)	J41	Comment	Added during verification	X	
A13076	EMSR	354(12/19)	J41	Comment	Added during verification	X	
S45397	CMTL	414(02/17)	J41	Comment	Added during verification	X	
S50007	CMTL	289(10/15)	J41	Comment	Added during verification	X	

(continued)

TABLE A-4 (continued) (Page 3 of 4) - ANALYSIS CARDS ONLY

Sample ID	Lab	Date to DM	Card Type	Card Contents	Remarks	Added by DM (X)	Sheet Missing (X)
W20051	ERCO	282(10/8)	J41	Comment	Added during verification	X	
W20280	GSNO	324(11/19)	J41 (6)	Comment	Added during verification	X	
S40564	GSNO	347(12/12)	J41	Comment	Added during verification	X	
W25727	CMTL	369(01/3)	J41	Comment	Added during verification	X	
W22189	WSU	324(11/19)	-	Pollutant D03	Information phoned in--no forms submitted	X	
S45003	CMTL	414(02/17)	J41	Comment	Added during verification	X	
A10047	SWRI	311(11/6)	J41	Comment	Added during verification	X	
S40070	SWRI	280(10/6)	J41	Comment (2 cds)	Added during verifidation	X	
A11635	EMSR	354(12/19)	J41	Comment	Added during verification	X	

(continued)

TABLE A-4 (continued) (Page 4 of 4) - ANALYSIS CARDS ONLY

Sample ID	Lab	Date to DM	Card Type	Card Contents	Remarks	Added by DM (X)	Sheet Missing (X)
W20063	PJBL	282(10/8)	J41	Comment (1)	Added during verififation	X	
S50320	GSNO	414(02/17)	J41	Comment (1)		X	
S45557	CMTL	414(02/17)	J41	Comment (1)	Added during verification	X	

TABLE A-5. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT LOG - SUMMARY

						Code Sheets Located		All Loca-ted	Code Sheets Not Located		Code Sheets Edited by DM		Total Agree-ment	Discrepancy				
Sample No.	Lab	Sample Date	Anal-ysis Date	Dates to DM System	# Anal. Cards	#CDS	#SHTS	(X)	#CDS	#SHTS	#CDS	#SHT	(X)	# Sheets OK	# Cards OK	# Sheets Not OK	# Cards Not OK	# Differ-ent Errors
Sample Data																		
71					238	227	68		11	6	7	4		50	206	18	21	21
Analysis Data																		
8	ACEE				511	539	49	X	0	0	108	12		35	442	14	97	9
14	BCL				328	340	29	X	0	0	2	1		17	329	12	13	13
10	ERCO				83	82	21		1	1	1	1		19	79	2	3	1
14	SWRI				293	291	32		4	3	20	2		26	284	6	7	6
7	PEDCO				180	180	17	X	0	0	0	0	X	7	180	0	0	0
3	EMSC				98	106	8	X	0	0	26	2		6	99	2	7	2
2	EMSR				22	20	4		2	2	0	0		4	20	0	0	0
1	IIT				16	16	3	X	0	0	11	2	X	3	16	0	0	0
4	GSNO				260	256	23		8	3	2	1		16	178	7	78	6
2	AES				5	5	5	X	0	0	3	3		3	3	2	2	2
3	TRW				173	189	14	X	0	0	0	0		10	172	4	17	4
10	GSLA				217	220	25	X	0	0	28	5		20	148	5	72	4
10	PJBL				401	604	50		1	1	0	0		31	385	19	219	13
9	CMTL				339	341	33		5	4	55	6		30	337	3	4	3
3	MWRI				284	302	20	X	0	0	94	6		23	284	3	18	3
1	WSV				1	0	0		1	1	0	0						

TABLE A-6. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT DISCREPANCY LOG - SUMMARY

		Change Submitted by Lab																
		Raw List		Other Written		Phone		Change by DM					Correct Change		Incorrect Change		Cannot Trace Change	
Sample No.	Lab	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
Sample Data																		
18								9	9	Raw data edit	9	9	9	9				
								10	9	Program changes corrected during raw data edit	10	9	10	9				
								2	2	Phone change from Sample Bank	2	2	1	1	1	1		
								1	1	Default values	1	1	1	1				
								1	1	Comment added	1	1	1	1				
Analysis Data																		
7	ACEE							13	2	Pollutant cards eliminated	19	3	19	3				
								7	5	Pollutant cards invalidated	7	5	7	5				
								72	6	BC → CS	72	6	72	6				
								4	2	Acid and base portions combined on internal QC sheets	4	2			4	2		
								96	15									
2	EMSL							6	1	Pollutant card eliminated	6	1	6	1				
								1	1	Pollutant card invalidated	1	1	1	1				
								7	2									
12	BCL							12	12	Pollutant card deleted	12	12	12	12				
								1	1	Lab coding error	1	1	1	1			1	1
6	SWRI	4	3					2	2	Pollutant card invalidated	2	2	2	2				
								4	3	Coding change made during verification	4	3						
								1	1	Conc. adjusted by 2.5 factor	1	1	1	1				
								7	6									

(continued)

TABLE A-6 (continued) (Page 2 of 3)

No. of Samples	Lab	Change Submitted by Lab						Change by DM		Other Change			Correct Change		Incorrect Change		Cannot Trace Change	
		Raw List		Other Written		Phone												
		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
2	TRW							13	2	Pollutant card invalidated	13	2	13	2				
								4	2	Pollutant card eliminated	4	2	4	2				
								17	4									
5	PJBL							10	7	Pollutant cards invalidated	10	7	10	7				
								22	4	Pollutant cards eliminated	22	4	22	4				
								110	9	Coding changes during verification	110	9	110	9				
								154	12	Repeat analysis	154	12	154	12				
								296	32									
4	GSLA							43	3	Method code correction	43	3	43	3			25	2
								1	1	Conc. adjusted by 2.5	1	1	1	1				
								3	1	Conc. values missing	3	1			3	1	3	1
								47	5									
2	MWRI							12	2	Pollutant cards eliminated	12	2	12	2				
3	CMTL							4	4	Pollutant cards invalidated	4	4	4	4				
								1	1	Pollutant cars eliminated	1	1	1	1				
								5	5									
2	AES			1	1					Concentration code changed	1	1	1	1				
								1	1	Coding change	1	1	1	1				
								2	2									

(continued)

TABLE A-6 (continued) (Page 3 of 3)

Sample ID	Lab	Change Submitted by Lab											Correct Change		Incorrect Change		Cannot Trace Change	
		Raw List		Other Written		Phone		Change by DM										
		#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	Other Change	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS	#CDS	#SHTS
2	GSNO							2	2	Pollutant card invalidated	2	2	2	2				
		6	2					76	6	Method code change	76	6	76	6				
										Comments changed by lab	6	2	2	2				
								84	10									
1	ERCO							3	2	Cards entered twice	3	2			3	2	3	2

TABLE A-7. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT PROBLEM LOG - SUMMARY

		Problem							
No. of Samples	Lab	Incorrect Change	Cannot Trace Change	Form No.	Poll/ Cas	Error Field	Value in DM	Correct Value	Comments
Sample Data									
1				Sample		Prep to QC			Incorrect value
Analysis Data									
1	ERCC			J08 J06					Cards entered twice
1	GSLA	X		J66					Values not entered
1	ACEE	X		J05					Acid and base portions added incorrectly

TABLE A-8. LOVE CANAL STUDY - DATA MANAGEMENT SYSTEM - AUDIT FOR CODE SHEETS NOT LOCATED - SUMMARY

No. of Samples	Lab	Date to DM	Card Type	Card Contents	Remarks	Added by DM (X)	Sheet Missing (X)
Sample Data							
2						X	
4							X
Analysis Data							
3	SWRI		J41		Comments	X	
2	EMSR		J41		Comments	X	
5	CMTL		J41		Comments	X	
1	ERCO		J41		Comments	X	
3	GSNO		J41		Comments	X	
1	WSU				Information phoned in	X	

(continued)

TABLE A-8 (continued) (Page 2 of 2)

No. of Samples	Lab	Date to DM	Card Type	Card Contents	Remarks	Added by DM (X)	Sheet Missing (X)
1	PJBL		J41	Comments		X	

GCA Technology Division

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To RoseMary Ellersick Date 9 June 1981

From Mary Havelock MCH

Subject Love Canal Data Management Audit

Eileen Conley's report on her audit of the Love Canal data management system gives a good general summary of her findings. Of particular note is the fact that not a single keypunch error was detected during the entire audit. Also of note is the fact that the data, as they were submitted to data management, required a great deal of editing and correcting.

The attached Tables 1 and 2 summarize (from Eileen's log sheets) the nature of the changes which data management (DM) made to the analysis data and sample data, respectively. About 12% of the analysis "cards," involving nearly one third of all samples, were edited by DM before they were even keypunched. During the verification process, about 12% of samples were corrected for analysis data and 17% of samples were corrected for sample data which were originally in error or missing. In addition, DM made changes to 9% of all analysis cards (involving 29% of the samples) to eliminate certain pollutant codes and method codes. By the time the verification process was complete, DM had made changes to a total of 64% of the samples being audited for analysis data and to 22% of the samples being audited for sample data.

The attached Table 3 shows the number of errors and omissions which we corrected for each laboratory. (This table does not include any changes caused by GCA (e.g., the ambiguous method code 625), nor does it include the invalidations specified by EPA.) There are no apparent differences in error rates between laboratories which verified the raw data listings and those which did not. Individual laboratories do, however, vary widely in their error rates, within each group.

Because we made a large number of corrections to the Love Canal data, and because errors are more likely to be introduced into a system when changes are made than when data are being entered from original source documents, we are especially pleased at the extremely low error rate revealed by the audit. As Eileen's Table 3 shows, she found that DM had made errors on only 0.3% of the cards which were audited.

The one problem identified in the sample data was due to an incorrect chain of custody number provided to DM, in writing, by the Sample Bank. It was not actually a DM error. We have now corrected this number in the verified and validated data bases.

Similarly, one of the three problems identified in the analysis data was caused by incorrect information provided to DM. In this case, DM had been operating on erroneous instructions from Acurex on combining the acid and base neutral fractions of their internal QC data for Method 625. New instructions from

Acurex enabled us to correct all such Acurex samples in the verified and validated data bases. This particular problem was brought to light during the audit.

The other two problems identified during the audit were ones of which we were aware prior to the audit. For some samples, compounds I15 and I16 were entered twice in the data base; for some other samples, some external QC data had not been entered. We have been able to make systematic changes to the data base to correct both these types of errors.

MCH/dlt

Attachments

cc: R. M. Bradway

Table 1: Audit Summary

Changes to Analysis Data

	Samples (101 in Audit)		Code Sheets (348 in Audit)		Cards (3211 in Audit)	
	No. Changes	% Changes	No. Changes	% Changes	No. Changes	% Changes
A. Edits to Code Sheets						
1. Edited by DM before keypunch	18	17.8	41	11.8	350	10.9
2. Cards added by DM	16	15.8	16	4.6	23	0.7
Sub-total	32*	31.7*	57	16.4	373	11.6
B. Changes by Labs						
1. Coding errors/changes	11	10.9	16	4.6	93	2.9
2. Repeat analysis deleted	1	1.0	12	3.4	154	4.8
Sub-total	12	11.9	28	8.0	247	7.7
Total Changes due to labs (A&B)	38*	37.6*				
C. Changes by DM						
1. Pollutants eliminated	24	23.8	25	7.2	76	2.4
2. Method Code 625 change	3	3.0	18	5.2	225	7.0
3. Correction factor	2	2.0	2	0.6	2	0.1
Sub-total	29	28.7	45	12.9	303	9.4
Total of All Changes to verified data base (A+B+C)	64*	63.4*				
D. Invalidations:						
Pollutants Invalidated	20	19.8	23	6.6	39	1.2

*Sub-totals and totals may appear to be incorrect because of overlap within their constituents.

Table 2: Audit Summary

Changes to Sample Data

	Samples (71 in Audit)		Code Sheets (74 in Audit)		Cards (240 in Audit)	
	No. Changed	% Changed	No. Changed	% Changed	No. Changed	% Changed
A. Edits to Code Sheet						
1. Edited by DM before keypunch.	4	5.6	4	5.4	7	2.9
2. Default values supplied	1	1.4	1	1.4	1	0.4
Sub-total	5	7.0	5	6.8	8	3.3
. Changes from Sample Bank						
1. Coding errors/changes	17	23.9	21	28.4	22	9.2
Total Changes to Sample Data (A+B)	22	31.0	26	35.1	30	12.5

Table 3: Audit Summary
Corrections to Love Canal Data Due to Laboratory Errors, Omissions, and Changes*

	Totals for Audit			Edits to Code Sheets						Changes by Labs						Total Corrections: Samples **	
				Samples		Code Sheets		Cards		Samples		Code Sheets		Cards			
Lab	Samples	Code Sheets	Cards	N	%	N	%	N	%	N	%	N	%	N	%	N	%
ACEE	8	49	511	4	50.0	12	24.5	108	21.1	1	12.5	2	4.1	4	0.8	4	50.0
† BCL	14	29	328	1	7.1	1	3.4	2	0.6	1	7.1	1	3.4	1	0.3	1	7.1
ERCO	10	21	83	3	30.0	3	14.3	3	3.6	0	--	0	--	0	--	3	30.0
SWRI	14	32	293	4	28.6	5	15.6	23	7.8	3	21.4	3	9.4	4	1.4	7	50.0
† PEDCO	7	17	180	0	--	0	--	0	--	0	--	0	--	0	--	0	--
EMSC	3	8	98	1	33.3	2	25.0	26	26.5	0	--	0	--	0	--	1	33.3
EMSR	2	4	22	2	100.0	2	50.0	2	9.1	0	--	0	--	0	--	2	100.0
IIT	1	3	16	1	100.0	2	66.7	11	68.8	0	--	0	--	0	--	1	100.0
† GSNO	4	23	260	3	75.0	4	17.4	5	1.9	1	25.0	2	8.7	6	2.3	3	75.0
AES	2	5	5	1	50.0	3	60.0	3	60.0	2	100.0	2	40.0	2	40.0	2	100.0
TRW	3	14	173	0	--	0	--	0	--	0	--	0	--	0	--	0	--
† GSLA	10	25	217	3	30.0	5	20.0	28	12.9	2	20.0	3	12.0	43	19.8	5	50.0
PJBL	10	50	401	2	20.0	1	0.4	1	0.2	2	20.0	15	30.0	187	46.6	3	30.0
† CMTL	9	33	339	5	55.6	11	33.3	60	17.7	0	--	0	--	0	--	5	55.6
† MWRI	3	20	284	1	33.3	6	30.0	94	33.1	0	--	0	--	0	--	1	33.3
WSU	1	0	1	0	--	--	--	--	--	0	--	-	--	0	--	0	--
Total for Labs	101	333	3211	31	30.7	57	17.1	366	11.4	12	11.9	28	8.4	247	7.7	38	37.6
Sample Bank	71	68	238	4	5.6	4	5.9	7	2.9	18	25.4	12	17.6	13	5.5	22	31.0

*This table does not include any changes to the data base which were caused by EPA or GCA, and it excludes invalidations.

**Totals in this column do not correspond directly to the total of the "edit" and "change" columns, because there is some overlap between those two columns, (i.e., some samples underwent both edits by DM and changes by the labs).

† Labs which did not verify the data listings.

APPENDIX B

SAMPLING AND ANALYTICAL INTERNAL QC CHECK

Page

Sampling Internal QC Checks B-2

Analytical Internal QC Checks B-15

6.0 SAMPLING INTERNAL QC CHECKS

The sampling program includes the collection of air, water, soil, sediment and biota samples and onsite measurements of meteorological conditions. The hydrogeologic study includes geophysical survey measurements, and the collection of groundwater samples from monitoring wells. Samples of unconsolidated well core sediments will also be collected.

Appendix A to this QA Plan presents the sampling procedures to be followed for collecting each type of sample and incorporates information on appropriate sample collection equipment, types of sample containers and their cleanup, preservation required, field blanks and chain-of-custody procedures. Calibration procedures for air sampling and meteorological equipment are included.

The tables in this section summarize the internal QC measures to be used in sample collection, meteorological and geophysical survey measurements by the sampling and geotechnical subcontractors. Groundwater samples are included with other water samples in Table 6.3.1 and well core sediments are included in Table 6.4.1 on soil and sediment sampling.

TABLE 6.1.1. AIR SAMPLING INTERNAL QC CHECKS

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics	1. DuPont P-125 Sampler		
Tenax collection	1a. Battery check at site, prior to startup	1a. Battery check LED should light	1a. Use backup pump
	1b. Low flow detector check (no load) at site prior to startup	1b. Low flow detector LED should not light	1b. Use backup pump
	1c. Low flow detector check (load imposed) at site prior to startup	1c. Low flow detector LED should light	1c. Use backup pump
	1d. Pump operation check at site, just after startup	1d. Pump should operate	1d. Use backup pump
	1e. Low flow detector check at site, just after startup	1e. Low flow detector LED should not light	1e. Use backup pump
	1f. Flow rate check[a] at site, just before end of sampling	1f. Low flow detector LED should not light	1f. Make notation on sampling sheet, sample tag, chain of custody form
	2. One Tenax field blank/sampling team/sampling day	2. To be determined	2a. Correct for blank 2b. Check sampling and analytical procedures 2c. Invalidate results
	3. 11% of samples collected in duplicate	3. Not applicable	3. Not applicable

(continued)

TABLE 6.1.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Pesticides/Related Organics	1. DuPont P-4000 Sampler		
Polyurethane foam collection	1a. Battery check at site, prior to startup	1a. Battery check LED should light	1a. Use backup pump
	1b. Low flow detector check (no load) at site prior to startup	1b. Low flow detector LED should not light	1b. Use backup pump
	1c. Low flow detector check (load imposed) at site, prior to startup	1c. Low flow detector LED should not light	1c. Use backup pump
	1d. Pump operation check at site, just after startup	1d. Low flow detector LED should not light	1d. Use backup pump
	1e. Low flow detector check at site, just after startup	1e. Low flow detector LED should not light	1e. Use backup pump
	1f. Flow rate check[b] at site, just before end of sampling	1f. Low flow detector LED should not light	1f. Make notation on sampling sheet, sample tag, chain of custody form
	2. One foam plug field blank/sampling team/sampling day	2. To be determined	2a. Correct for blank 2b. Check sampling and analytical procedures 2c. Invalidate results
	3. 15% of samples collected in duplicate	3. Not applicable	3. Not applicable

(continued)

TABLE 6.1.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Metals Hi-Vol collection	1a. Flow recorder zero at site, prior to startup	1a. Chart should be set at zero	1a. Adjust
	1b. Initial flow rate check, 5 minutes after startup	1b. Initial stabilized flow should be within ±10% of established initial flow	1b. Use backup system
	1c. Flow rate range at end of sampling	1c. Mean flow rate should be between 30-60 C.F.M	1c. Make notations
	1d. Filter condition at end of sampling	1d. No evidence of leakage	1d. Make notations
	2. 18% samples collected in duplicate	2. Not applicable	2. Not applicable

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[a] Geomet Technologies, Inc. (GTI) Procedure GTI/LC-A-OP-001.

[b] Procedure GTI/LC-A-OP-002.

TABLE 6.1.2. AIR SAMPLING EQUIPMENT CALIBRATION QC CHECKS

Equipment	Calibration check	Control limits	Planned corrective action
DuPont P-125 Air Sampler	1. DuPont flow rate calibration system and bubble tubes[a] before/after sampling day.	1a. Flow rate range 26-30 cc/min.	1a. Repair pump.
		1b. Replicate bubble tube runs within ±5% of mean flow rate.	1b. Remove pump from service.
	2. Flow rate calibration as above using increased pressure drop simulating media loading before/after sampling day.	2. Flow rate with increased resistance must be within ±5% of mean flow rate.	2a. Repair pump. 2b. Remove pump from service.
DuPont P-4000 Air Sampler	1. Flow rate calibration with DuPont calibration system and bubble tubes.[b]	1a. Flow rate range 1270 ±5% cc/min.	1a. Repair pump.
		1b. Replicate bubble tube runs must be within ±5% of mean flow rate.	1b. Remove pump from service.
	2. Flow rate calibration as above using increased pressure drop simulation media loading before/after sampling day.	2. Flow rate with increased resistance must be within ±5% of mean flow rate.	2a. Repair pump. 2b. Remove pump from service.

(continued)

TABLE 6.1.2 (continued)

Equipment	Calibration check	Control limits	Planned corrective action
High Volume Air Sampling System			
Sampler (Flow Recorder)	1a. Flow rate calibration with orifice system[c] on receipt, after major maintenance and at study completion.	1a. $Q_o - Q_c \leq 0.05\ Q_c$ Q_o=Observed flow rate Q_c=Calib. curve flow rate.	1a. Rerun points for which the control limit is exceeded until acceptance is obtained.
Elapsed Time Meter	1b. Accuracy check against Base reference chronometer[d] at start and completion of study	1b. ±2 min/24 hrs.	1b. Adjust or replace meter.
On/Off Timer	1c. Tripping accuracy check against elapsed time meter at start and completion of study.	1c. ±15 min/24 hrs.	1c. Adjust or replace timer.
Base Reference Chronometer	1a. Check synchronization against U.S. Naval Observatory Master Clock[e] daily.	1a. ±1 sec/ synchronization	1a. Repeat synchronization to attain acceptability.
	1b. Check accuracy against U.S. Naval Observatory Master Clock daily.	1b. ±1 sec/24 hr accuracy.	1b. Adjust or replace

(continued)

TABLE 6.1.2 (continued)

Equipment	Calibration check	Control limits	Planned corrective action
Digital LCD Quartz Watches	1a. Synchronize against Base reference Chronometer[f] each sampling day.	1a. ±2 sec synchronization.	1a. Repeat to achieve synchronization.
	1b. Check accuracy against Base reference Chronometer at end of sampling.	1b. ±10 sec/12 hrs.	1b. Replace watch.
Stopwatches	1. Check time accuracy against Base reference Chronometer[g] at beginning and end of study or in case of accidental mishandling.	1. ±0.6 sec/10 min (0.1%).	1. Replace stopwatch.
Bubble Tubes and Burets	1. Check volume accuracy with water displacement[h] at beginning of study.	1. ±1% for 50 ml tubes.	1. Use empirical correction factor.

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[a] Geomet Technologies, Inc. (GTI) Procedure GTI-LC-A-CP-008.

[b] Procedure GTI/LC-A-CP-009

[c] Procedure GTI/LC-A-CP-007.

[d] Procedure GTI/LC-A-CP-004.

[e] Procedure GTI/LC-A-CP-002.

[f] Procedure GTI/LC-A-CP-003.

[g] Procedure GTI/LC-A-CP-006.

[h] Procedure GTI/LC-A-CP-001.

TABLE 6.2.1. METEOROLOGICAL MONITORING INTERNAL QC CHECKS

Parameter(s) measured	Operation check	Control limits	Planned corrective action
Temperature-Outdoor (Hygrothermograph)	1. Check against aspirated psychrometer thermometer[a] weekly.	1. ±1.0°C (2°F)	1a. Adjustment and recalibration. 1b. Determine extent of data affected.
Relative Humidity-Outdoor (Hygrothermograph)	1. Check against relative humidity determined with sling psychrometer[a] weekly.	1. ±3% R.H.	1a. Recheck. 1b. If outside limit recalibrate.
Relative Humidity-Indoor (Aspirated Psychrometer)	1. Thermometers during each use. 2. Reservoir water level during each use. 3. Fan operation[b] during each use.	1. Visual inspection. 2. Visual inspection. 3. Visual inspection.	1. Replace if damaged. 2. Refill reservoir. 3. Replace batteries.
Wind Speed (Anemometer)	1. Readout to be checked for reasonability against visual observations of existing meteorological conditions daily.[c]	1. Reasonable correlation.	1a. Calibration check. 1b. Recalibrate.
Wind Direction (Wind sensor and recorder)	1. Readout to be checked for reasonability against visual observations of existing meteorological conditions daily.[c]	1. Reasonable correlation.	1. Calibration check if observations warrant action.
Precipitation (Tipping-bucket rain gauge)	1. Readout to be checked against existing meteorological conditions daily. 2. Visual check for gross response during or after rainfall.	1. Reasonable correlation. 2. Proper response judged visually.	1. Calibration check if observations warrant action. 2a. Free blocked bucket or repair poor gauge contact.[d] 2b. Determine extent of data affected.

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[a] GTI Procedure GTI/LC-M-OP-004.

[b] GTI Procedure GTI/LC-M-OP-005.

[c] GTI Procedure GTI/LC-M-OP-002.

[d] GTI Procedure GTI/LC-M-OP-001.

TABLE 6.2.2. METEOROLOGICAL MONITORING EQUIPMENT CALIBRATION QC CHECKS

Equipment	Calibration check	Control limits	Planned corrective action
Hygrothermograph	1. Temperature checked at 2 points against reference thermometers[a] at start and completion of study.	1. ±1°C (±2°F).	1. Repeat calibration or replace unit if necessary.
	2. RH checked at 2 points against sling or asperated psychrometer[b] at start and completion of study.	2. ±3%RH(20-80%RH).	2. Recalibrate or replace if necessary.
Aspirated Psychrometer	1. Temperature checked at 2 points against reference thermometers[c] monthly.	1. ±0.5°C	1. Replace thermometers.
Wind Speed/Direction Measurement System	1. Wind direction-Align true north against well-documented true north landmarks. Check 3 other directions on chart[d] at start and completion of study.	1. ±3° azimuth.	1a. Adjust transducer assembly. 1b. Replace unit.
Rain Gauge	1. Check digital accumulator with water equivalent to 1 inch precipitation[e] at start and completion of study.	1. ±0.02 inches accuracy.	1a. Make repairs or adjustments in the field. 1b. Replace gauge.

[a] Geomet Technologies, Inc. (GTI) Procedure GTI/LC-M-CP-005.

[b] Procedure GTI/LC-M-CP-004.

[c] Procedure GTI/LC-M-CP-006.

[d] Procedure GTI/LC-M-CP-002.

[e] Procedure GTI/LC-M-CP-001.

TABLE 6.3.1 WATER SAMPLING INTERNAL QC CHECKS

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics	1. One reagent water field blank/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. 5% of samples collected in triplicate.	2. Not applicable.	2. Not applicable.
Semivolatile Organics	1. One reagent water field blank/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. 5% of samples collected in triplicate.	2. Not applicable.	2. Not applicable.
Pesticides	1. One reagent water field blank/sample type/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. 5% of samples collected in triplicate.	2. Not applicable.	
Metals	1. One reagent water field blank/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. 5% of samples collected in triplicate.	2. Not applicable.	2. Not applicable.
Fluorides/Nitrates	1. One reagent water field blank/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. 5% of samples collected in triplicate.	2. Not applicable.	2. Not applicable.
Dioxins (TCDD)	1. One reagent Type 1 water field blank/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. 5% of samples collected in triplicate.	2. Not applicable.	2. Not applicable.
Radioactivity	1. One reagent water field blank/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. All samples collected in duplicate.	2. Not applicable.	2. Not applicable.
Total Organic Carbon (TOC)/ Total Organic Halogens (TOX)/ pH/Conductivity (Groundwater only)	1. One reagent water field blank/sampling team/sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. 5% of samples collected in triplicate.	2. Not applicable.	2. Not applicable.

TABLE 6.4.1 SOIL AND SEDIMENT SAMPLING INTERNAL QC CHECKS

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics	1. One reagent water field blank/sampling team/ sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. Collect 10% of samples in triplicate.	2. Not applicable.	2. Not applicable.
Semivolatile Organics	1. One reagent water field blank/sampling team/ sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. Collect 10% of samples in triplicate.	2. Not applicable.	2. Not applicable.
Pesticides	1. One reagent water field blank/sampling team/ sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. Collect 10% of samples in triplicate.	2. Not applicable.	2. Not applicable.
Inorganic (Metals)	1. One reagent water field blank/sampling team/ sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. Collect 10% of samples in triplicate.	2. Not applicable.	2. Not applicable.
Dioxins (TCDD)	1. One reagent water field blank/sampling team/ sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. Collect 10% of samples in triplicate.	2. Not applicable.	2. Not applicable.
Radioactivity	1. One reagent water field blank/sampling team/ sampling day.	1. No significant concentrations found.	1a. Correct for field blank. 1b. Check sampling and analytical procedures. 1c. Invalidate results.
	2. Collect 10% of samples in duplicate.	2. Not applicable.	2. Not applicable.

TABLE 6.5.1 BIOTA SAMPLING EQUIPMENT QC CHECKS

Equipment	Operation check	Control limits	Planned corrective action
VICTOR-Mouse and Rat Traps	1. Test tripping mechanism before setting.	1. Proper tripping of bait pedal.	1. Repair or replace.
HAVE-A-HEART Live Traps	1. Test tripping mechanism before setting.	1. Proper tripping of bait pedal.	1. Repair or replace.
Trap Line inspection	1. Survey of trap line for security hourly.	1. Trap line must not be disturbed.	1. Make notation on field data sheets, sample tag, chain-of-custody form.

TABLE 6.6.1 GEOPHYSICAL SURVEY EQUIPMENT QC CHECKS

Equipment	Operation check	Planned corrective action
Ground Penetrating Radar	1. Calibrate with 10 nanosecond standard daily.	1. Not applicable.
	2. Reference to a feature at known depth at each site.	2. Correct data reports.
Electromagnetic Sensor	1. Check system linearity by recording zero and upper scale readings on each traverse.	1. Correct data reports.
Resistivity Sensor	1. Check with dummy load.	1. Correct data reports.
Magnetometer	1. Calibrate against magnet traceable to a primary standard.	1. Not applicable.
	2. Check for sensitivity at each site.	2. Correct data reports

7.0 ANALYTICAL INTERNAL QC CHECKS

Appendix B to this QA Plan presents the analytical procedures to be used for Love Canal Study samples classified according to the media sampled and the analysis performed. A section on quality control procedures fully incorporating all EPA QC requirements is provided for each analytical procedure.

This information has been provided to all analytical subcontractors as part of their subcontract document and, again, in the sections of Appendix B pertinent to their project analytical work. Each subcontractor's QA Plan has been evaluated to ensure that it incorporates EPA's required internal QC measures and identifies a project QA coordinator responsible for implementing these measures.

The tables in this section summarize the quality control procedures given in Appendix B; the reader interested in more detail should refer to that volume.

7.1 AIR MONITORING

Air samples will be collected on Tenax cartridges, foam plugs and Hi-Vol filters. Unexposed collection media will be provided to the appropriate analytical laboratory for use as method blanks. In addition, primary calibration standards and calibration check standards for analysis of Tenax cartridges and dioxin samples will be provided. All standards for foam plug analysis should be obtained through the Quality Assurance Section, HERL/RTP.

Instrument calibration specifications and calibration checks, appropriate internal standards, frequency of replicate analyses and method blanks are outlined in Table 7.1.1. The compounds to be spiked onto foam plugs to provide a Laboratory control standard (LCS) are identified and concentration levels given.

TABLE 7.1.1 ANALYTICAL INTERNAL OC CHECKS - AIR SAMPLES

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics on Tenax	1. Tuning of mass spectrometer - Document 50 ng BFB and/or 50 ng DFTPP injected before analysis/analysis day.	1a. DFTPP - Method 624, Table 3[a] 1b. BFB - as follows: Mass — Ion Abundance 50 — 15-40% of the base peak 75 — 30-60% of the base peak 95 — base peak, 100% relative abundance 96 — 5-9% of the base peak 173 — less than 1% of the base peak 174 — greater than 50% of the base peak 175 — 5-9% of mass 174 176 — greater than 50% of the base peak 176 — greater than 94% but less than 100% of 174 177 — 5-9% of mass 176	1. Retune spectrometer
	2. Verify capillary column performance - Inject before analysis/analysis day the "Grob" mixture: Acetophenone 2,6-Dimethylphenol 2,6-Dimethylaniline Nonanone Ethyl benzene p-Xylene	2a. RESOLUTION = $\frac{2(W_1 - W_2)}{W_1 + W_2}$ <1.20 where W_1 = average base width of ethylbenzene measured at the base W_2 = average base width of p-xylene measured at the base 2b. PERCENT PEAK ASYMMETRY FACTOR (PAF) % PAF = $\frac{B}{F} \times 100$ where B = area of back half of peak F = area of front half of peak Both measured at 10 percent above baseline % PAF for acetophenone < 260 % PAF for nonanone < 130 These criteria (2b) do not apply to cases in which frontal tailing or frontal shoulders are apparent. These situations, where F is greater than B, are highly unlikely to occur and must be evaluated on an individual basis. 2c. ACIDITY TEST (A.T.) = 1 ± 0.1 A.T. = $\frac{PAWB}{PAA}$ where PAWB = peak area of dimethylanile PAA = peak area of acetophenone 2d. BASICITY TEST (B.T.) = 0.8 ± 0.03 B.T. = $\frac{PAWA}{PAA}$ where PAWA = peak area of dimethylphenol PAA = peak area of acetophenone	2a. Check analytical procedure 2b. Rerun "Grob" mixture 2c. Replace capillary column
	3. Internal standard (optional) - Add hexafluorobenzene to every Tenax cartridge (blank, sample, standard)	3. Not applicable.	3. Not applicable.
	4. Thermal desorption system check - Verify proper operating temperatures and flow rates/8 hours of analysis.	4. To be determined	4a. Adjust to appropriate levels 4b. Verify analytical results obtained while flows and/or temperatures were incorrect.

(continued)

TABLE 7.1.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics on Tenax	5. Calibration check of GC/MS system - Analyze one standard Tenax cartridge, including the internal standard if applicable/8 hours of analysis (during first half of this 8 hour period).	5. Deviation less than ±20 percent of actual.	5a. Check analytical procedure. 5b. Analyze a second reference standard. 5c. Invalidate results and generate new standard curve.
	6. Method blank (blank Tenax cartridge) - Analyze one blank Tenax cartridge/8 hours of analysis and/or after sample(s) with heavy organic loading. Maintain log of sequence in which blanks are run.	6. No significant concentrations found.	6a. Check analytical procedure. 6b. Analyze reference sample. 6c. Invalidate results.
Pesticides and related Compounds on Polyurethane Foam Plugs	1. Calibration of instrument - Generate 3-point calibration curve of all compounds to be quantified before analysis of samples/analysis day.	1. Not applicable.	1. Not applicable.
	2. Calibration check of instrument - Analyze single concentration mixed standard of compounds to be quantified after every fifth samples.	2. Deviation less than ±6% from calibration curve for all compounds detected in samples.	2a. Generate fresh calibration curve. 2b. Re-analyze samples run since last acceptable standard check.
	3. Method blank (blank foam plug) - Extract and analyze one blank foam plug/analysis batch^b/analysis day.	3. No significant concentrations found.	3a. Check analytical procedure. 3b. Correct for blank.
	4. Internal standard - Add 2,2'-Dichloro-p-xylene to every sample extract at a known concentration.	4. Not applicable.	4. Not applicable.
	5. Qualitative compound check - Analyze one mixed standard of all compounds for qualitative analysis after every tenth sample.	5. Verify retention times.	5a. Check analytical procedure. 5b. Analyze a second reference sample. 5c. Invalidate results.
	6. Laboratory control standard (LCS) - Analyze one LCS/analysis batch^b/analysis day. LCS to be spiked foam plug containing 250-400 ng per whole plug of the following: Lindane Hexachlorobenzene Hexachlorocyclopentadiene 1,2,3,4-Tetrachlorobenzene 1,2,3-Trichlorobenzene 1,2,4-Trichlorobenzene 1,3,5-Trichlorobenzene 2,4,5-Trichlorophenol Pentachlorobenzene	6. To be determined - acceptable recovery levels for spiked polyurethane foam plugs have not yet been established and must be determined as the program progresses.	6a. Check analytical procedure. 6b. Analyze a second reference sample. 6c. Invalidate results.

(continued)

TABLE 7.1.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Pesticides and Related Compounds on Polyurethane Foam Plugs	7. Sensitivity check - Verify proper instrument sensitivity as part of calibration check.	7. Lindane (225 pg) gives 50 percent of full scale deflection.	7a. Adjust to appropriate levels. 7b. Recalibrate as necessary.
Metals on Hi-Vol Filters	1. Calibration and standardization - Generate calibration curve by analysis of 5 working standards of each element to be quantified. Average of two burns to form calibration curve. Required for each session of analysis (3-3½ hours).	1. Not applicable.	1. Not applicable.
	2. Calibration checks of instrument - a. **Analyze the zero standard** after every 20 samples. b. Analyze LOQC or HIQC after every 10 samples.	2a. No significant drift observed. **2b. Control limits for LOQC/HIQC are specified in** computer control program.[c]	2a. Check analytical procedure. 2b. Analyze a second reference sample. 2c. Invalidate results and recalibration.
	3. Method blank (blank hi-vol filter) - a. Thirty (30) filters analyzed prior to start of program. b. Analyze one filter blank for every 20 samples.	3a. Establish mean levels and discrimination limits for each element to correct analytical results for filter contribution. 3b. No significant concentration found and levels meet criteria established in preliminary study.	3a. Check analytical procedure. 3b. Analyze reference sample. 3c. Analyze reagent blank. 3d. Invalidate results.
	4. Method blank (reagent water) - a. Analyze reagents for elements of interest prior to start of program. b. Optionally, analyze one reagent blank for every 50 samples.	4. No significant concentrations found.	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.
	5. **Replicate analysis - Extract and** and analyze a duplicate aliquot of one (1) of every 20 samples.	5. To be determined.	5a. Check analytical procedure. 5b. Analyze reference sample. 5c. Invalidate results.
Dioxin (2,3,7,8-TCDD)	**1. Internal standard - Add to each sample a known amount of ^{37}Cl$_4$-TCDD to determine percent recovery.**	1. Not applicable.	1. Report percent recovered for each sample.
	2. Confirmation of 2,3,7,8-TCDD using LRGC/HRMS.	2a. Both TCDD peaks (m/z 320, m/z 322) must be present. 2b. TCDD peaks (m/z 320, m/z 322) must be greater than 2.5 times the noise level. 2c. TCDD peak intensities (m/z 320, m/z 322) must show correct chlorine isotope ratio (0.8:1.0). 2d. TCDD GC retention time must be correct.	2. Terminate analysis and report TCDD not detected.

(continued)

TABLE 7.1.1 (continued)

Pollutants measured	Operation check	Control Limits	Planned corrective action
Dioxin (2,3,7,8-TCDD)	3. Confirmation of 2,3,7,8-TCDD using capillary column GC/HRMS - If criteria of No. 2 above are met, sample extracts are reanalyzed by this technique.	3a. Correct capillary column GC/HRMS retention time for TCDD. 3b. Correct chlorine isotope ratio for the molecular ions (m/z 320, m/z 322). 3c. Correct capillary column GC/HRMS multiple ion monitoring responses for TCDD masses and ^{37}Cl-TCDD mass (simultaneous response for elemental composition of m/z 320, m/z 322, m/z 328). 3d. Correct responses for co-injection of sample fortified with ^{37}Cl-TCDD and TCDD standard. 3e. Response of m/z 320 and m/z 322 (TCDD) must be greater than 2.5 times the noise level.	3. Terminate analysis and report TCDD not detected.

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[a] Method 624, Federal Register, Vol. 44, No. 233, December 3, 1979. pp. 69532-69539.

[b] Analysis batch = Group of samples processed as a set, usually containing 15 or fewer samples.

[c] Analysis for metals on hi-vols is performed by EMSL/RTP. Control limits have been established by that group and are automatically checked by the computer control program prior to analysis of the next sample.

7.2 WATER MONITORING

Several types of water - residential sumps, sewer and surface waters, drinking water supplies and ground waters - will be analyzed for the pollutants listed in Table 7.2.1. The compounds specified for use as internal standards or organic surrogate compounds will be provided to the subcontractor laboratories as stated in Appendix B.

Laboratory control standards (LCS) will be employed to control systematic method and operator errors. The LCS is a solution of one or more analytes of known concentration in reagent water; each will be prepared using either EMSL/Cincinnati quality control concentrates or standards supplied by the individual laboratory. The analytes which must be included, as a minimum, for each method are given in Table 7.2.1 along with the required concentration range. A control chart should be maintained for each of the analytes using the control limits given in Table 7.2.1.

The same table includes instrument calibration specifications and calibration checks, frequency of method blanks and replicate analyses; the metals, anions, and concentration ranges to be used to spike each type of water sample are given.

TABLE 7.2.1 ANALYTICAL INTERNAL QC CHECKS - WATER SAMPLES

Pollutants measured	Operation check	Control Limits	Planned corrective action
Volatile Organics	1. Tuning of mass spectrometer - Document 50 ng BFB and/or 50 ng DFTPP injected before analysis/analysis day.	1a. DFTPP - Method 624, Table 3[a]. 1b. BFB - as follows:	1. Retune spectrometer.
		Mass — Ion Abundance	
		50 — 15-40% of the base peak	
		75 — 30-60% of the base peak	
		95 — base peak, 100% relative abundance	
		96 — 5-9% of the base peak	
		173 — less than 1% of the base peak	
		174 — greater than 50% of the base peak	
		175 — 5-9% of mass 174	
		176 — greater than 50% of the base peak	
		176 — greater than 94% but less than 100% of 174	
		177 — 5-9% of mass 176	
	2. Calibration check of GC/MS system - Analyze single concentration mixed standards/analysis shift (8 hours).	2. Deviation less than ±20 percent from actual.	2. Recalibrate system.
	3. Method blank (reagent water) - Analyze method blank before analysis batch[b]/analysis day.	3. No significant concentrations found.	3a. Check analytical procedure. 3b. Correct for blank.
	4. Surrogate compounds - Add the following compounds to every sample at a concentration of 5-25 μg/l:	4. Calculated as percent of true value:	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.
	Fluorobenzene	81-107	
	p-Bromofluorobenzene	88-118	
	5. Internal standards (optional) - Add the following compounds to every sample at known concentration: 1,4-Difluorobenzene Pentafluorobenzene 2-Bromo-1-chloropropane[c]	5. Method 624, Sections 5.6 and 6.4.[a]	5a. Check analytical procedure. 5b. Analyze reference sample. 5c. Invalidate results.
	6. Laboratory control standard (LCS) - Analyze one (1) LCS/analysis batch[b]/analysis day. LCS to contain 5-25 μg/l of the following:	6. Calculated as percent of true value:	6a. Check analytical procedure. 6b. Analyze second reference sample. 6c. Invalidate results.
	Benzene	79-107	
	Chloroform	90-100	
	Bromoform	76-107	
	sym-Tetrachloroethane	67-110	
	p-Bromofluorobenzene	88-118	
	Carbon tetrachloride	85-102	
	Fluorobenzene	81-107	
	Trichloroethylene	93-105	
	Tetrachloroethylene	93-120	
	Chlorobenzene	69-107	

(continued)

TABLE 7.2.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics	7. Replicate analysis - Analyze, using complete procedure, a second aliquot of one (1) of every ten (10) samples.	7. To be determined.	7a. Check analytical procedure 7b. Analyze reference sample. 7c. Invalidate results.
Acrolein, Acrylonitrile	1. Method blank (reagent water) - Analyze method blank before analysis batch^b/analysis day.	1. No significant concentrations found.	1a. Check analytical procedure 1b. Correct for blank.
	2. Purging efficiency - Determine purging efficiency for each compound before analysis/analysis day.	2. Acrolein, 80-90% Acrylonitrile, 93-103%	2. Check analytical procedure.
	3. Laboratory control standard (LCS) - Analyze one LCS per analysis batch^b/analysis day. LCS to contain 5-25 µg/l of each: Acrolein Acrylonitrile	3. ±2 standard deviations.	3a. Check analytical procedure. 3b. Analyze second reference sample. 3c. Invalidate results.
Semivolatile Organics	1. Tuning of mass spectrometer - Document injection of 50 ng DFTPP before analysis/analysis day.	1. Method 625, Table 10^d	1. Retune spectrometer.
	2. Verify a capillary column performance - a. Inject simultaneously, using 1 µl injection size, 100 ng Pentachlorophenol and benzidine. b. Analysis of the "Grob" mixture: Acetophenone 2,6-Dimethylphenol 2,6-Dimethylaniline Nonanone Ethyl Benzene p-Xylene	2. Tailing factor for those compounds ≤1.5.	2a. Check analytical procedure. 2b. Analyze reference sample. 2c. Replace capillary column.
	3. Method blank (reagent water) - Analyze one method blank/analysis batch^b/analysis day.	3. No significant concentrations found.	3a. Check analytical procedure 3b. Correct for blank.
	4. Calibration check of GC/MS system - Analyze single concentration mixed standard containing the internal standards/8 hours of analysis.	4. Deviation less than ±20 percent from actual.	4. Recalibrate system.

(continued)

TABLE 7.2.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Semivolatile Organics	5. Surrogate compounds - Add the following compounds to every sample at a concentration of 5-25 µg/l:	5. Calculated as percent of true value:	5a. Check analytical procedure. 5b. Analyze reference sample. 5c. Invalidate results.
	2-Fluorophenol	18-58	
	1-Fluoronaphthalene	33-88	
	4,4'-Dibromooctafluorobiphenyl	34-98	
	6. Internal standards - Add the following compounds to each environmental sample at a known concentration: Naphthalene d_8 Anthracene d_{10} Chrysene d_{12}	6. Method 625, Section 6.4[d]	6a. Check analytical procedures. 6b. Analyze reference sample. 6c. Invalidate results.
	7. Laboratory control standards (LCS) - Analyze one (1) LCS/analysis batch[b]/analysis day. LCS to contain 5-25 µg/l of the following compounds:	7. Calculated as percent of true value:	7a. Check analytical procedure. 7b. Analyze second reference sample. 7c. Invalidate results.
	1,4-dichlorobenzene	16-64	
	1,2,4-trichlorobenzene	36-96	
	1,2,3,4-tetrachlorobenzene	35-59	
	Fluoranthene	40-118	
	2,4,6-trichlorophenol	46-82	
	2-chloronaphthalene	34-98	
	2,6-dinitrotoluene	34-94	
	4-nitrophenol	36-68	
	2-fluorophenol	18-58	
	Pentachlorophenol	63-111	
	Beta-benzenehexachloride	19-119	
	1-fluoronaphthalene	33-81	
	4,4-dibromobiphenyl	36-94	
	4,4-dibromooctafluorobiphenyl	34-98	
	Di-m-butylphthalate	45-125	
	8. Replicate analysis - Analyze, using complete procedure, a second aliquot of one (1) of every ten (10) samples.	8. To be determined.	8a. Check analytical procedure. 8b. Analyze reference sample. 8c. Invalidate results.
Benzidine	1. Method blank (reagent water) - Analyze one (1) method blank before analysis/analysis day.	1. No significant concentrations found.	1a. Check analytical procedure. 1b. Correct for blank.
	2. Laboratory control standard (LSC) - Analyze one (1) LCS/analysis batch[b]/analysis day. LCS to contain 5-25 µg/l of benzidine.	2. ±2 standard deviations.	2a. Check analytical procedure. 2b. Analyze second reference sample. 2c. Invalidate results.

(continued)

TABLE 7.2.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Hexachlorocyclopentadiene	1. Document injection port temperature.	1. Not applicable.	1. Not applicable.
	2. Method blank (reagent water) - Analyze one (1) method blank/analysis batch^b/analysis day.	2. No significant concentrations found.	2a. Check analytical procedure. 2b. Correct for blank.
	3. Laboratory control standard (LCS) - Analyze one (1) LCS/analysis batch^b/analysis day. LCS to contain 5-25 µg/l hexachorocyclopentadiene.	3. ±2 standard deviations.	3a. Check analytical procedure. 3b. Analyze second reference sample. 3c. Invalidate results.
Pesticides	1. Calibration and standardization - Perform as required by Method 608, Section 7^e.	1. Method 608, Section 7^e.	1. Recalibrate and restandardize instrument.
	2. Method blank (reagent water) - Analyze one (1) reagent blank/analysis batch^b/analysis day.	2. No significant concentrations found.	2a. Check analytical procedure. 2b. Correct for blank.
	3. Laboratory control standard (LCS) - Analyze one (1) LCS/analysis batch^b/analysis day. LCS to contain (at a minimum) 5-25 µg/l Aroclor 1242.	3. ±2 standard deviations.	3a. Check analytical procedure. 3b. Analyze second reference sample. 3c. Invalidate results.
	4. Replicate analysis - Analyze, using the complete procedure, a second aliquot of one (1) of every ten (10) samples.	4. To be determined.	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.
	5. Confirmation by GC/MS - Confirm identified pesticides using GC/MS analysis.	5. Identification confirmed.	5a. Analyze replicate aliquot by Method 608. 5b. Invalidate original Method 608 result.
Metals	1. Calibration and standardization - Calibrate and standardize instrument as required in analytical procedures.^{f}	1. Standard analytical methods.^{f}	1. Recalibrate and restandardize instrument.
	2. Method blank (reagent water) - Analyze one (1) method blank/analysis batch^b/analysis day.	2. No significant concentrations found.	2a. Check analytical procedure. 2b. Correct for blank.

(continued)

TABLE 7.2.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Metals	3. Sample spiking (Initial study) - Add compounds of actual elements of interest to portions of the first ten (10) samples of each type of water. Spiked levels, as follows:	3. 85-115% recovery of added element.	3. Use method of standard additions to quantitate samples of that water type.
	Antimony 0.25 mg/l Arsenic 0.05 mg/l Barium 1.0 mg/l Beryllium 0.015 mg/l Cadmium 0.01 mg/l Chromium 0.05 mg/l Lead 0.05 mg/l Mercury 0.002 mg/l Nickel 0.15 mg/l Selenium 0.01 mg/l Thallium 1.0 mg/l Zinc 5.0 mg/l		
	(Spiked levels given prior to concentration.)		
	4. Sample spiking (check) - If control limits of No. 3 above are met, spike one (1) of the next twenty (20) of each type of sample with the concentrations specified above.	4. 85-115% recovery of added element.	4. Use method of standard additions to quantitate samples of that water type.
	5. Laboratory control standard (LCS) - Analyze one (1) LCS/analysis batch^b/analysis day. LCS to contain the following elements, as appropriate, at concentrations specified:	5. Calculated as percent of true value:	5a. Check analytical procedure. 5b. Analyze second reference sample. 5c. Invalidate results.
	Antimony ≃0.5 mg/l	90-110	
	Arsenic ≃0.3 mg/l	89-111	
	Barium ≃1.0 mg/l	95-105	
	Beryllium ≃0.5 mg/l	95-105	
	Cadmium ≃0.07 mg/l	95-105	
	Chromium ≃0.25	95-105	
	Lead ≃0.4 mg/l	92-108	
	Mercury 1-5 µg/l	65-110	
	Nickel ≃0.3 mg/l	96-104	
	Selenium 5-20 µg/l	92-108	
	Silver ≃0.05 mg/l	92-108	
	Thallium ≃0.05 mg/l	90-110	
	Zinc ≃0.4 mg/l	96-104	

(continued)

TABLE 7.2.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Metals	6. Replicate analysis - Analyze, using the complete procedure, a second aliquot of one (1) of every ten (10) samples.	6. To be determined.	6a. Check analytical procedure. 6b. Analyze reference sample. 6c. Invalidate results.
Fluoride, Nitrate	1. Calibrate and standardize as prescribed in the appropriate analytical methods.[f]	1. Not applicable.	1. Not applicable.
	2. Method blank (reagent water) - Analyze one (1) method blank/analysis batch[b]/analysis day.	2. No significant concentrations found.	2a. Check analytical procedures. 2b. Correct for blank.
	3. Sample spiking (initial study) - Add compounds of the anions of interest to portions of the first ten (10) samples of each type of water. Spike levels, as follows: Fluoride 1.0 mg/l Nitrate 10.0 mg/l	3. 85-115% recovery of added anion.	3. Use method of standard additions to quantitate samples of that type water.
	4. Sample spiking (check) - If control limits of No. 3 above are met, spike one (1) of the next twenty (20) of each type water with the concentrations as specified above.	4. 85-115% recovery of added anion.	4. Use method of standard additions to quantitate samples of that type water.
	5. Laboratory control standard - (LCS) - Analyze one (1) LCS/analysis batch /analysis day. LCS to contain, as appropriate, the following:	5. Calculated as percent of true value:	5a. Check analytical procedure. 5b. Analyze second reference sample. 5c. Invalidate results.
	Fluoride 0.5-1.5 mg/l	92-108	
	Nitrate 2-10 mg/l	92-108	
	6. Replicate analysis - Analyze, using the complete procedure, a second aliquot of one (1) of every ten (10) samples.	6. To be determined.	6a. Check analytical procedure. 6b. Analyze reference sample. 6c. Invalidate results.
Total Organic Carbon (TOC)	1. Calibrate and standardize as required by Method 415.1[f]	1. Not applicable.	1. Not applicable.
	2. Method blank (reagent water) - Analyze one (1) method blank/analysis batch[b]/analysis day.	2. No significant concentrations found.	2a. Check analytical procedure.

(continued)

TABLE 7.2.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Total Organic Carbon (TOC)	3. Replicate analysis - Analyze, using the complete procedure, a second aliquot of one (1) of every ten (10) samples.	3. To be determined.	3a. Check analytical procedure. 3b. Analyze reference sample. 3c. Invalidate results.
Total Organic Halogens (TOX)	1. Calibrate and standardize as required by Dohrmann DX-20 instructions.	1. Not applicable.	1. Not applicable.
	2. Method blank (reagent water) - Analyze one (1) method blank/analysis batch^{b}/analysis day.	2. No significant concentrations found.	2a. Check analytical procedure. 2b. Correct for blank.
	3. Replicate analysis - Analyze, using the complete procedure, a second aliquot of one (1) of every ten (10) samples.	3. To be determined.	3a. Check analytical procedure. 3b. Analyze reference sample. 3c. Invalidate results.
pH	1. Calibrate and standardize as required by Method 150.1^{f} using two (2) or more standard buffer solutions.	1. Not applicable.	1. Not applicable.
	2. Calibration check - Analyze a standard buffer solution after every ten (10) samples.	2. Deviation less than ±0.1 pH units.	2. Recalibrate instrument.
	3. Replicate analysis - Analyze, using the complete procedure a second aliquot of one (1) of of every ten (10) samples.	3. To be determined.	3a. Check analytical procedure. 3b. Analyze reference sample. 3c. Invalidate results.
Conductivity^{g}	1. Standardize and calibrate daily before analysis using KCl solutions.	1. Not applicable.	1. Not applicable.
	2. Calibration check - Analyze a standard KCl solution after every ten (10) samples.	2. Derivation less than ±1 percent or less than ±1 µmho/cm, whichever is greater.	2a. Recalibrate instrument. 2b. Reanalyze all samples run since last acceptable calibration check.
	3. Replicate analysis - Analyze, using full procedure, a second aliquot of one (1) of every ten (10) samples.	3. To be determined.	3a. Check analytical procedure. 3b. Analyze reference sample. 3c. Invalidate results.

(continued)

TABLE 7.2.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Dioxin (2,3,7,8-TCDD)	1. Internal standard - Add to each sample a known amount of $^{37}C_4$-TCDD to determine percent recovery for each sample.	1. Not applicable.	1. Report percent recovered for each sample.
	2. Confirmation of 2,3,7,8-TCDD using LRGC/HRMS.	2a. Both TCDD peaks (m/z 320, m/z 322) must be present. 2b. TCDD peaks (m/z 320, m/z 322) must be greater than 2.5 times the noise level. 2c. TCDD peak intensities (m/z 320, m/z 322) must show correct chlorine isotope ratio (0.8:1.0). 2d. TCDD GC retention time must be correct.	2. Terminate analysis and report TCDD not detected.
	3. Confirmation of 2,3,7,8-TCDD using capillary column GC/HRMS. If criteria of No. 2 above are met, sample extracts are reanalyzed by this technique.	3a. Correct capillary column GC/HRMS retention time for TCDD. 3b. Correct chlorine isotope ratio for the molecular ions (m/z 320, m/z 322). 3c. Correct capillary column GC/HRMS multiple ion monitoring responses for TCDD masses and ^{37}Cl-TCDD mass (simultaneous responses for elemental composition of m/z 320, m/z 322, m/z 328). 3d. Correct responses for co-injection of sample fortified with ^{37}Cl-TCDD and TCDD standard. 3e. Response of m/z 320 and m/z 322 (TCDD) must be greater than 2.5 times the noise level.	3. Terminate analysis and report TCDD not detected.
Radioactivity	QC procedures for radioactivity measurements will be provided by EMSL, Las Vegas.		

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[a] Method 624, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69532-69539.

[b] Analysis batch = group of samples processed as a set, usually containing 15 or fewer samples.

[c] May be present in Love Canal samples.

[d] Method 625, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69540-69552.

[e] Method 608, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69501-69509.

[f] Methods for Chemical Analysis of Water and Wastes, EPA-600/4-79-020.

[g] Method 205, Standard Methods for the Examination of Water and Wastes, 14th edition, American Public Health Assoc., 1975.

7.3 SOIL AND SEDIMENT SAMPLE ANALYSIS

Soils from home sites and other wet and dry areas and sediments from sumps, sewers, rivers and streams will be collected for analysis. Unconsolidated sediment well core samples will also be collected; Table 7.3.1 gives the pollutant classes measured in the samples. The compounds specified for use as internal standards, organic spiking and surrogate compounds will be provided to the analytical subcontractors.

The Laboratory control standard (LCS) used for soil and sediment samples is an NBS river sediment which is spiked with specified organic compounds for different types of analyses. Instrument calibration specifications and calibration checks, frequency of method blanks and replicate analyses and the metals to be spiked into samples are outlined in Table 7.3.1.

TABLE 7.3.1 ANALYTICAL INTERNAL QC CHECKS - SOIL AND SEDIMENT SAMPLES

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics	1. Tuning of mass spectrometer - Document 50 ng BFB and/or 50 ng DFTPP injected before analysis/analysis day.	1a. DFTPP - Method 624, Table 3[a] 1b. BFB - as follows: Mass — Ion Abundance 50 — 15-40% of the base peak 75 — 30-60% of the base peak 95 — base peak, 100% relative abundance 96 — 5-9% of the base peak 173 — less than 1% of the base peak 174 — greater than 50% of the base peak 175 — 5-9% of mass 174 176 — greater than 50% of the base peak 176 — greater than 94% but less than 100% of 174 177 — 5-9% of mass 176	1. Retune spectrometer.
	2. Calibration check of GC/MS system - Analyze single concentration mixed standard containing internal standards/analysis shift (8 hours).	2. Deviation less than ±20 percent from actual.	2. Recalibrate system.
	3. Method blank (reagent water) - Analyze method blank before analysis batch[b]/analysis day.	3. No significant concentrations found.	3a. Check analytical procedure. 3b. Correct for blank.
	4. Surrogate compounds - Add the following compounds to every sample at a concentration of 100 ppb: Carbon tetrachloride $^{13}C_1$ 1,2-Dichloroethane d_4 p-Chlorotoluene d_4	4. ±2 standard deviations.	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.
	5. Internal standards - add the following compounds to every sample at known concentration: Dichloromethane d_2 Toluene d_8 Benzene d_6	5. Method 624, Sections 5.6 and 6.4[a]	5a. Check analytical procedure. 5b. Analyze reference sample. 5c. Invalidate results.
	6. Laboratory control standard (LCS) - Analyze one (1) LCS for every twenty (20) soil or sediment samples. LCS consists of 1 gram NBS-1645 sediment spiked with Purgeables B Mixture to give 100 ppb of the following: Chlorobenzene Toluene Benzene	6. Calculate as percent recovery.	6a. Check analytical procedure. 6b. Analyze second reference sample. 6c. Invalidate results.

(continued)

TABLE 7.3.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics	7. Replicate analysis - analyze, using complete procedure, a second aliquot of one (1) of every ten (10) samples.	7. To be determined.	7a. Check analytical procedure. 7b. Analyze reference sample. 7c. Invalidate results.
Semivolatile Organics	1. Tuning of mass spectrometer - Document injection of 50 ng DFTPP before analysis/analysis day.	1. Method 625, Table 10[c]	1. Retune spectrometer.
	2. Verify capillary column performance - a. Inject simultaneously, using 1 µl injection size, 100 ng pentachlorophenol and benzidine. b. Analysis of the "Grob" mixture: Acetophenone 2,6-Dimethylphenol 2,6-Dimethylaniline Nonanone Ethyl Benzene p-Xylene	2. Tailing factor for those compounds ≤ 1.5.	2a. Check analytical procedure. 2b. Analyze reference sample. 2c. Invalidate results.
	3. Method blank (reagent water) - Analyze one (1) method blank/analysis batch[b]/analysis day.	3. No significant concentrations found.	3a. Check analytical procedure. 3b. Correct for blank.
	4. Calibration check of GC/MS system - Analyze single concentration mixed standard containing the internal standards/8 hours of analysis.	4. Deviations less than ±20 percent from actual.	4. Recalibrate system.
	5. Surrogate compounds - Add the following compounds to every sample at a concentration of 250 µg/50 g sample: Hexachlorobenzene $^{13}C_6$ Pentachlorophenol $^{13}C_6$ 2-Chlorophenol $^{13}C_6$ Tetrachlorobenzene $^{13}C_6$ p-Chlorotoluene d_4	5. ±2 standard deviations.	5a. Check analytical procedure. 5b. Analyze reference sample. 5c. Invalidate results.
	6. Internal standards - Add the following compounds to every environmental sample at a known concentration: Naphthalene d_8 Anthracene d_{10} Chrysene d_{12}	6. Method 625, Section 6.4[c]	6a. Check analytical procedure. 6b. Analyze second reference sample. 6c. Invalidate results.

(continued)

TABLE 7.3.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Semivolatile Organics	7. Laboratory Control standard (LCS) - Analyze one (1) LCS for every twenty (20) soil or sediment samples. LCS to consist of 5 grams NBS 1645 sediment spiked to contain 5-10 ppm of the following: Base Neutrals: 1,2,4-Trichlorobenzene; 2,4-Dinitrotoluene; Di-n-butyl phthalate; Pyrene; N-nitroso-di-n-propylamine; 1,4-Dichlorobenzene Acids: Pentachlorophenol; 2-Chlorophenol; P-Chloro-m-cresol; 4-Nitrophenol	7. Calculate as percent recovery.	7a. Check analytical procedure. 7b. Analyze second reference sample. 7c. Invalidate results.
	8. Replicate analysis - Analyze, using complete procedures, a second aliquot of one (1) of every ten (10) samples.	8. To be determined.	8a. Check analytical procedure. 8b. Analyze reference sample. 8c. Invalidate results.
Pesticides	1. Calibration and standardization - Perform as required by Method 608, Section 7^d.	1. Method 608, Section 7^d	1. Recalibrate and restandardize instrument.
	2. Method blank (reagent water) - Analyze one (1) reagent blank/analysis batch^b/analysis day.	2. No significant concentrations found.	2a. Check analytical procedure. 2b. Correct for blank.
	3. Laboratory control standard (LCS) - Analyze one (1) LCS for every twenty (20) soil or sediment samples. LCS to consist of 5 grams NBS 1645 sediment spiked to contain 5-10 ppm of the following: Heptachlor Aldrin Dieldrin	3. Calculate as percent recovery.	3a. Check analytical procedure. 3b. Analyze second reference. sample. 3c. Invalidate results.
	4. Replicate analysis - Analyze, using complete procedure, a second aliquot of one (1) of every ten (10) samples.	4. To be determined.	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.
	5. Confirm identified pesticides using Method 625.	5. Identification confirmed.	5a. Analyze replicate aliquot by Method 608. 5b. Invalidate original Method 608 redults.

(continued)

TABLE 7.3.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Metals	1. Calibration and standardization - Calibrate and standardize instrument as required in analtyical procedures.^{e}	1. Standard analytical methods.^{e}	1. Recalibrate and restandardize instrument.
	2. Sample spiking - Add compounds of actual elements of interest to portions of first ten (10) samples of each type (soil, sediment). Spike level is to be two (2) times the endogenous level or ten (10) times the detection limit.	2. Recovery 85-115% for each element.	2. Analyze by Method of standard additions^e.
	3. Method blank (reagent water) - Analyze one (1) reagent blank/ analysis batch^d/analysis day.	3. No significant concentrations found.	3a. Check analytical procedure. 3b. Correct for blank.
	4. Laboratory control standard (LCS) - Analyze one (1) LCS for every twenty (20) soil or sediment samples. LCS to consist of 5 grams NBS 1645 sediment with values below as initial mean for control charts: Antimony (51) mg/kg Arsenic (66) mg/kg Cadmium 10.2 mg/kg Chromium 2.96 WT % Copper 109 mg/kg Lead 714 mg/kg Mercury 1.1 mg/kg Nickel 45.8 mg/kg Thallium 1.44 mg/kg Zinc 1720 mg/kg	4. Maintain control chart for each element. Develop 99 and 95 percent confidence levels (control and warning limits) through repetitive analyses.	4a. Check analytical procedure 4b. Analyze second reference sample. 4c. Invalidate results.
	5. Replicate analysis - Analyze, using complete procedure, a second aliquot of one (1) of every ten (10) samples.	5. To be determined.	5a. Check analytical procedure. 5b. Analyze reference sample. 5c. Invalidate results.
Dioxin (2,3,7,8-TCDD)	1. Internal standard - Add to each sample a known amount of $^{37}Cl_4$-TCDD to determine percent recovery for each sample.	1. Not applicable.	1. Report percent recovered for each sample.

(continued)

TABLE 7.3.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Dioxin (2,3,7,8-TCDD)	2. Confirmation of 2,3,7,8-TCDD using LRGC/HRMS.	2a. Both TCDD peaks (m/z 320, m/z, 322) must be present. 2b. TCDD peaks (m/z 320, m/z 322) must be greater than 2.5 times the noise level. 2c. TCDD peak intensities (m/z 320, m/z 322) must show correct chlorine isotope ratio (0.8:1.0). 2d. TCDD GC retention time must be correct.	2. Terminate analysis and report TCDD not detected.
	3. Confirmation of 2,3,7,8-TCDD using capillary column GC/HRMS. If criteria of No. 2 above are met, sample extracts are reanalyzed by this technique.	3a. Correct capillary column GC/HRMS retention time for TCDD 3b. Correct chlorine isotope ratio for the molecular ions (m/z 320, m/z 322). 3c. Correct capillary column GC/HRMS multiple ion monitoring responses for TCDD masses and ^{37}Cl-TCDD (simultaneous response for elemental composition of m/z 320, m/z 322, m/z 328). 3d. Correct responses for co-injection of sample fortified with ^{37}Cl-TCDD and TCDD standard. 3e. Response of m/z 320 and m/z 322 (TCDD) must be greater than 2.5 times the noise level.	3. Terminate analysis and report TCDD not detected.
Radiactivity	Internal QC checks for radioactivity measurements will be provided by EMSL, Las Vegas.		

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[a] Method 624, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69532-69539.

[b] Analysis batch = group of samples processed as a set, usually containing 15 or fewer samples.

[c] Method 625, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69540-69552.

[d] Method 608, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69501-69509.

[e] Methods for Chemical Analysis of Water and Wastes, EPA-600-4-79-020. Atomic Absorption Spectroscopy procedures for metals.

7.4 BIOMONITORING PROGRAM

Mice, crayfish and earthworms will be collected for organic tissue analysis; potatoes and oatmeal will also be analyzed for organic compounds. Hair samples from mice and pet dogs and green leaf vegetation will be analyzed for metals. The specified surrogates, internal standards and Laboratory control standard (LCS) materials will be provided to the subcontractors.

Different types of LCS are used as appropriate. They include: reagent water spiked with specified organic compounds, an NBS Trace Elements in Water standard, reagent water spiked with metals and an NBS Orchard Leaves SRM containing metals. Instrument calibration specifications and calibration checks and the frequency of method blanks and replicate analyses are outlined in Table 7.4.1.

TABLE 7.4.1 ANALYTICAL INTERNAL QC CHECKS - BIOTA SAMPLES

Pollutants measured	Operation check	Control limits	Planned corrective action
Semivolatiles and Pesticides in Animal Tissue	1. Tuning of mass spectrometer - Document injection of 50 ng DTFPP before analysis/analysis day.	1. Method 625, Table 10[a]	1. Retune spectrometer.
	2. Calibration check of GC/MS system - Analyze one (1) single concentration mixed standard/8 hours of analysis.	2. Deviation less than 20 percent from actual.	2. Recalibrate instrument.
	3. Reagent blank - Analyze all reagent lots to be used prior to initiation of program.	3. No significant concentrations found.	3. Redistill solvents, recovering only 80 percent.
	4. Method blank (reagent water) - Analyze one (1) reagent blank/analysis batch[b]/analysis day.	4. No significant concentrations found.	4a. Check analytical procedure. 4b. Correct for blank.
	5. Repeated extraction - Re-extract every fifth sample to monitor initial extraction efficiency.	5. To be determined.	5. To be determined.
	6. Replicate analysis (depends on nature of sample) - Analyze, using complete procedure, a second aliquot of one (1) of every ten (10) samples.	6. To be determined.	6a. Check analytical procedure. 6b. Analyze reference sample. 6c. Invalidate results.
Volatile Organics in Foodstuffs	1. Calibration and Standardization - Calibrate GC using standards of compounds of interest at three (3) concentrations prior to analysis/analysis day.	1. Not applicable	1. Not applicable
	2. Calibration check - Inject single concentration calibration standard of all compounds/8 hours of analysis.	2. Deviation less than ±20 percent from actual.	2a. Check analytical procedure. 2b. Analyze second reference sample. 2c. Invalidate results.
	3. Method blank (reagent water) - Analyze one (1) method blank prior to analysis/analysis day.	3. No significant concentrations found.	3a. Check analytical procedure. 3b. Correct for blank.
	4. Surrogate compounds - Add to every sample at 5-25 µg/l the following compounds:	4. Calculated as percent of true value.	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.
	Fluorobenzene	81-107	
	p-Bromofluorobenzene	88-118	

(continued)

TABLE 7.4.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Volatile Organics in Foodstuffs	5. Laboratory control standard (LCS) - Analyze one (1) LCS/analysis batch[b]/analysis day. LCS to contain 5-25 µg/l of the following compounds:	5. Calculated as percent of true value:	5a. Check analytical procedure. 5b. Analyze second reference sample. 5c. Invalidate results.
	Benzene	79-107	
	Chloroform	90-100	
	Bromoform	76-107	
	sym-Tetrachloroethane	67-110	
	p-Bromofluorobenzene	88-118	
	Carbon tetrachloride	85-102	
	Fluorobenzene	81-107	
	Trichloroethylene	93-105	
	Tetrachloroethylene	93-120	
	Chlorobenzene	69-107	
	6. Replicate analysis - Analyze using complete procedure, a second aliquot of one (1) of every ten (10) samples.	6. To be determined.	6a. Check analytical procedure. 6b. Analyze reference sample. 6c. Invalidate results.
Trace Elements in Hair	1. Calibration and Standardization - Calibrate instrument(s) according to the procedures outlined in the standard analytical methods.[c]	1. Not applicable	1. Not applicable
	2. Method blank (reagent water) - Analyze with the samples one (1) method blank for approximately every twenty (20) hair samples to achieve, at a minimum, three (3) blanks for dog hair samples plus two (2) blanks for mouse hair samples.	2. No significant concentrations found.	2a. Check analytical procedure. 2b. Correct for blank.
	3. Laboratory control standard (LCS) - Analyze with the samples one (1) LCS of each type for approximately every twenty (20) hair samples to achieve, at a minimum, two (2) LCSs of each type for dog hair samples plus two (2) LCSs of each type for mouse hair samples.	3. ±2 standard deviations.	3a. Check analytical procedure. 3b. Analyze second reference sample. 3c. Invalidate results.
	a. One LCS to be used is the NBS SRM 1643a, trace elements in water, with content in ng/g as follows:		
	Arsenic 76 ± 7		
	Barium 46 ± 2		

(continued)

TABLE 7.4.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Trace Elements in Hair	Beryllium 19 ± 2 Cadmium 10 ± 1 Chromium 17 ± 2 Copper 18 ± 2 Lead 27 ± 2 Mercury* (<0.2) Nickel 55 ± 3 Selenium 11 ± 1 Silver 2.8 ± 0.3 Zinc 72 ± 4 *Mercury is not certified. b. The second LCS consists of laboratory water spiked with the elements of interest at a concentration approximately 4 to 5 times the analytical detection limit or about at the level of SRM 1643a.		
	4. Replicate analysis (if sufficient amounts of sample are available) - Analyze, using complete procedures a second aliquot of one (1) of every ten (10) samples.	4. To be determined.	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.
Trace Elements in Vegetation	1. Calibration and standardization - Calibrate instrument(s) according to the procedures outlined in the standard analytical methods.[c,d,e]	1. Not applicable	1. Not applicable
	2. Method blank (reagent water) - Analyze with the samples one (1) method blank for approximately every twenty (20) vegetation samples to achieve, at a minimum, two (2) blanks for the total number of vegetation samples.	2. No significant concentrations found.	2a. Check analytical procedure. 2b. Correct for blank.
	3. Laboratory control standard (LCS) - Analyze with the samples one (1) of each type LCS for approximately every twenty (20) vegetation samples to achieve, at a minimum, two (2) of each type LCS for the total number of vegetation samples. a. One LCS to be used is the NBS SRM 1571, Orchard Leaves, with content in µg/g as follows: Arsenic 10 Antimony 2.9	3. ±2 standard deviations.	3a. Check analytical procedure. 3b. Analyze second reference sample. 3c. Invalidate results.

(continued)

TABLE 7.4.1 (continued)

Pollutants measured	Operation check	Control limits	Planned corrective action
Trace Elements in Vegetation	Barium* 44 Beryllium 0.027 Cadmium 0.11 Chromium 2.6 Lead 45 Mercury 0.155 Nickel 1.3 Selenium 0.08 Zinc 25 *Barium is not certified.		
	b. The second type of LCS consists of laboratory water spiked with the trace elements of interest at a concentration approximately 4-5 times the analytical detection limit or about the level of SRM 1571.		
	4. Replicate analysis (if sufficient amounts of sample are available) - Analyze, using complete procedures, a second aliquot of one (1) of every ten (10) samples.	4. To be determined.	4a. Check analytical procedure. 4b. Analyze reference sample. 4c. Invalidate results.

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[a] Method 625, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69540-69552.

[b] Analysis batch = group of samples processed as a set, usually containing 15 or fewer samples.

[c] Methods for Chemical Analysis of Water and Wastes EPA-600/4-79-020.

[d] ICP Method, Federal Register, Vol. 44, No. 233, December 3, 1979, pp. 69559-69564.

[e] Munns, R. K. and D. C. Holland, Rapid Digestion and Flameless Atomic Absorption Spectroscopy of Mercury in Fish: Collaborative Study, J. Assoc. Off. Anal. Chem. 60, 833, 1977.

APPENDIX C

CORRECTIVE ACTION REPORT FORMS

	Page
Sample Collection and Handling	C-2
Custody Records	C-20
Analytical	C-26
QC Check Samples/Data Handling	C-43

Sample Collection and Handling CA Forms

Corrective Action Request Form No. LC 1-619-026 - 001

Originator R.M. ELLERSICK Date 9/2/80

Person Responsible for Replying K. McGREGOR/R.M. ELLERSICK Contract Involved CCA 1-619-026

Description of problem and when identified: Possible methylene chloride contamination of sediment samples collected for priority pollutant analysis during TCDD special study. Brought to originators' attention during onsite audit of CCA field office - had been identified earlier.

State cause of problem, if known or suspected: Container covers prepared for TCDD samples were used for priority pollutant samples.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

9/2/80 Ken McGregor will monitor analytical results on these samples for methylene chloride contamination.

10/1/80 RME will follow-up. - Appropriate followup-to note sample numbers and check final results.

Samples sent to CompuChem/Mead for Volatile Organics

S50008
S50011
S50014
S50015
S50019
S50022
S50025
S50031
S50033
S50034
S50037
S50043
S50048
S50050
S50053
S50054
S50059
S50062
S50065

S50092 blank for all priority pollutant analyses in group.

Samples sent to EMSL/CINN for Vol. Org.: S50067, S50070

CA Initially Approved By: R.M. Ellersick Date: 9/2/80

Follow-up Dates 10/1

Final CA Approval By: Date:

Information copies to:

RESPONSIBLE PERSON: K. McGREGOR

QA MANAGER: R.M. ELLERSICK

DEPARTMENT MANAGER: R.M. BRADWAY

Corrective Action Request Form No LC-1-619-026-002

Originator R.M. ELLERSICK　　Date 9/2/80

Person Responsible for Replying K. McGRECOR / R.M. ELLERSICK　　Contract Involved

Description of problem and when identified: Possible organic contamination of all samples collected through 21 August 1980 — except water samples collected for volatile organics. Brought to originator's attention during onsite audit of GTI field office on 21 August 1980 — had been questioned earlier.

State cause of problem, if known or suspected: Use of adhesive-backed teflon to line sample container covers

Sequence of Corrective Action: (If no responsible perso is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

8/21/80 RME - Stop use of adhesive-backed teflon. Agreed 8/21/80
9/2/80 KMcG. - Has obtained samples of the teflon used - will have analyzed to determine likely contaminants.
KMcG will monitor analytical results on these samples.
10/1/80 RME will follow-up.
10/3/80 RME checked on sample container liners in use. No adhesive-backed teflon in use.

CA Initially Approved By: R.M. Ellersick　　Date: 9/2/80

Follow-up Dates 10/1

Final CA Approval By: RME　　Date: 10/3/80 Problem Solved

Information copies to:

RESPONSIBLE PERSON: K. McGREGOR

QA MANAGER: R.M. ELLERSICK

DEPARTMENT MANAGER: R.M. BRADWAY

Corrective Action Request Form No. LC-1-619-026-003

Originator R.M. ELLERSICK Date 2/3/81

Person Responsible for Replying

Contract Involved LC 1-619-026

Description of problem and when identified: Collected soil samples for volatiles analysis opened in sample bank and transferred to smaller containers to enable shipment as "Poison B". S40172 – S40177, S40180, S40181 collected 8/26/80 and 8/23/80.

State cause of problem, if known or suspected: Not known these would have to be shipped "Poison B".

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

8/27/80 Sample bank solved shipping problem by re-packing samples; Sample bank clarified which samples needed "Poison B" handling.

2/3/81 RME – Checked Sample bank log which notes change to 1 quart.

CA Initially Approved By: SD Date: 8/27/80

Follow-up Dates

Final CA Approval By: RME Date: 2/3/81 Problem Explained

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-004

Originator	SDiamond	Date	1-19-81
Person Responsible for Replying	SDiamond	Contract Involved	1-619-026

Description of problem and when identified: W20067 - W20072 sumps Samples rec'd from field in one gallon containers. These require special ~~sampling~~ handling (Poison B) and are restricted shipping. Also W20077 - W20079. 9-21-80. (?) (Logs show these samples shipped 8/26, 8/29.)

State cause of problem, if known or suspected: misunderstanding of field personnel as to what type of samples are restricted

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

(?) 9-21-80 Samples were opened and split by SB personnel. One quart of material was sent to the lab for each sample.

Clarification of restricted samples made by SD. All restricted samples should be 1 quart or less of material.

2/3/81 RME - Check of Sample Bank Water Log shows none of these samples collected on 8/23/80 were for volatiles. Only W20077-W20079 marked 1 qt. taken. (8/22 - TCDD). No problem should have been caused since only volatile contamination would be expected to occur.

CA Initially Approved By: S.D. Date: 8/26, 8/27/80

Follow-up Dates 2/3/81

Final CA Approval By: RME Date: 2/3/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: SDiamond

QA MANAGER: RMEllerick

DEPARTMENT MANAGER: RBradway

Corrective Action Request Form No. LC-1-619-026-005

Originator SADiamond Date 1-19-81

Person Responsible for Replying SADiamond Contract Involved 1-619-026

Description of problem and when identified: 9-12-80 ; W20429 (TOC/TOX)- confusion between JRB's field & lab blanks - type of water to use for each.

State cause of problem, if known or suspected: a misunderstanding of type of blanks by field personnel and SB personnel.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

9-12-80 SB questioned JRB's terminology of "field" and "lab" blanks. JRB and B. Bouchard (GCA) explained "lab" blanks (AES DDI H_2O) are carried by each team into the field & the H_2O is not exposed. "Field" blanks are a rinse of the sampling equipment used. This blank uses Bell aerospace distilled water.

9-12-80 RME was asked by the SB to clairify the different types of blanks.

9-17-80 RME distributed a memo which included explination of field blanks.

1/31/81 - RME - Copy of memo attached. "Use DDI H_2O for all blanks!!"

CA Initially Approved By: ______ Date: ______

Follow-up Dates ______

Final CA Approval By: RME Date: 1/30/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: SADiamond

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: RBradway

LC-1-619-026-005

TO: GTI, JRB, AES, GCA Field Personnel
FROM: RoseMary Ellersick
SUBJECT: Clarification of Field Blanks
DATE: September 11, 1980, Revised September 15, 1980

The purpose of a field blank is to monitor sample handling procedures, including container cleanup, and document that contamination has not occurred. The field blank is to be carried to the sampling site, not exposed to the sampled air, water, soil, etc. but handled in the same way as collected samples. The field blank will remain in the refrigerated container (picnic cooler, etc.) used to transport collected samples while the sampling team collects its assigned samples.

The field blank is analyzed by the laboratory analyzing the samples, therefore, a field blank is required for each type of sample collected and for each media (air, water, soil, etc.) sampled. The following table should clarify this. Unless otherwise stated, the field blank is DDI water* in a clean sample container of the same type and size used for collected samples.

If the same team is sampling different types of waters, one field blank/sample type will be sufficient. If the same team is sampling different media, such as water and soil or water and sediment, or soil and sediment, field blanks for each sample type must be provided for each media.

FIELD BLANKS REQUIRED PER SAMPLING TEAM PER SAMPLING DAY

Air

Sample Type	Field Blank
Volatiles	Tenax Cartridge
Semivolatiles/Pesticides	Foam Plug Module

Water, Soil and Sediment

Sample Type

Volatiles
Semivolatiles
Pesticides
Nitrates, Fluorides
Metals
TCDD
TOC/TOX
Radioactivity - DDI water for water samples
- Empty container for soil/sediment samples.

*Use water from the Continental Treatment System in the AES laboratories.

Rose Mary Ellersick

RoseMary Ellersick
QA Manager

cc: R. Bradway
K. McGregor
D. Cogley

Corrective Action Request Form No. LC-1-619-026-006

Originator SIDiamond Date 1-19-81

Person Responsible for Replying SIDiamond Contract Involved 1-619-026

Description of problem and when identified: 9-10-80; W20360, W20361, W20365 - QA/QC sump site (vol. samples). Field personnel took only 3 of the required 6 samples at this site.

State cause of problem, if known or suspected: a misunderstanding of sampling procedures.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

9-10-80 the samples were processed through the SB. One vol. sample was sent to EMSC and two vol. samples were sent, as individual samples, to a laboratory.

9-11-80 GEOMET personnel was informed of correct QA/QC site sampling by ECA Field Office.

9-15-80 problem written up in SB problem log.

CA Initially Approved By: Date:

Follow-up Dates

Final CA Approval By: RME Date: 1/30/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: SIDiamond

QA MANAGER: RMEllerick

DEPARTMENT MANAGER: RBradway

Corrective Action Request Form No. LC-1-619-026-007

Originator SADiamond Date 1-19-81

Person Responsible for Replying SADiamond/P. McGlew Contract Involved 1-619-026

Description of problem and when identified: 10-5-80; Transport Study, Not enough ~~sampl~~ tenax to run a complete transport study. Needed 5 tenax only had 3 tenax tubes.

State cause of problem, if known or suspected: Many broken tenax in batch rec'd from PEDCO; used the few spares.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10-5-80 P. McGlew and SADiamond. Since the wind direction was correct for a transport study and also the fact no transport studies had been done as of this date, it was decided to proceed. One blank was dropped from strata 2 base house so only 4 tenax tubes were needed. 3 spare tenax were avaiable. the sample inside the fenced in area area was dropped. On this same date a regular air study was preformed - it was felt that data could be used to supplement the blank & strata 11 sample. Bob Bradway was informed of this by PMG & SAD.

CA Initially Approved By: Date:

Follow-up Dates

Final CA Approval By: RME Date: 1/30/81 Problem Explained

Information copies to:

RESPONSIBLE PERSON: SADiamond /P. McGlew

QA MANAGER: RMEllefsick

DEPARTMENT MANAGER: RBradway

Corrective Action Request Form No. LC-1-619-026-008

Originator SADiamond

Date 1-19-81

Person Responsible for Replying SADiamond

Contract Involved 1-619-026

Description of problem and when identified: QA/QC site not labled properly by field personnel and handled incorrectly by sample bank.
W20051 - W20056, W20059 - W20061, W20074 - W20085, W20090 - W20092. All three sets of samples were sent to the same lab - none to EMSC.

State cause of problem, if known or suspected: incorrect labling in field.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

- Sump sample, QA/QC site (triplicate) - GEOMET
- The processing mistake was not noticed until later on in the study. A notation was made in the master logs. ~~and~~ GEOMET was informed by the SB how to handle a triplicate & duplicate QA/QC site. This information was to be written in the "Remarks" area of the sample tags.

CA Initially Approved By:

Date:

Follow-up Dates

Final CA Approval By: RME

Date: 1/30/81 Problem Explained

Information copies to:

RESPONSIBLE PERSON: SADiamond

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: RBradway

Corrective Action Request Form No. LC-1-619-026-009

Originator S.Diamond
Date 1-29-81

Person Responsible for Replying S.Diamond / P. McGlew
Contract Involved 1-619-026

Description of problem and when identified: 10-14-80; transport study No air sample blanks run during night air campaign nor duplicates (tenax).

State cause of problem, if known or suspected: to enable a transport study to be preformed. There was not enough fresh tenax because of the extra night studies.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10-14-80 P. McGlew / S.Diamond in conference w/ R. Bradway decided to drop the night tenax blanks and duplicates to allow excess tubes for transport studies

CA Initially Approved By: ______ Date: ______

Follow-up Dates ______

Final CA Approval By: RME
Date: 1/30/81 Problem Explained.

Information copies to:

RESPONSIBLE PERSON: S.Diamond / P. McGlew

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: RBradway

Corrective Action Request Form No. LC-1-619-026-010

Originator S.Diamond

Date 1-29-80

Person Responsible for Replying S.Diamond

Contract Involved 1-619-026

Description of problem and when identified: W21030 vols.
sent to EMSL CINN and they were not removed
from shipping container before container
was returned to SB. 10-7-80

State cause of problem, if known or suspected: overlooked sample -
did not check cofc correctly

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10-7-80
One set of vols left in cooler & returned
to SB.
The set was sent back to EPA-EMSL-Cinn
for analysis. G. McKee was notified of problem.
1/30/81 RME Check on Original Sampling Date = 9/24/80.

CA Initially Approved By: ____________ Date: ____________

Follow-up Dates ____________

Final CA Approval By: RME Date: 1/30/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: S.Diamond

QA MANAGER: R.M.Ellersick

DEPARTMENT MANAGER: R.Bradway

Corrective Action Request Form No. LC-1-619-026-011

Originator S Diamond Date 1-29-81

Person Responsible for Replying S Diamond Contract Involved 1-619-026

Description of problem and when identified: W21309 metal gr H_2O 10-13-80 → sent to ERCO & returned to SB.

Ground water sample

State cause of problem, if known or suspected: overlooked sample & did not check C of C correctly.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10-13-80 - notified ERCO of problem - voided sample because warm.

CA Initially Approved By: Date:

Follow-up Dates

Final CA Approval By: RME Date: 1/30/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: S Diamond

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: R. Bradway

Corrective Action Request Form No. LC-1-619-026-012

Originator S.Diamond

Date 1-29-81

Person Responsible for Replying S.Diamond

Contract Involved 1-619-026

Description of problem and when identified: S45247 & S45227 10-15-80
Inorganic samples sent to CMTL by mistake.
then ~~F~~ Federal Express sent them to the SB.

State cause of problem, if known or suspected: wrong address by SB
& then Fed Exp. confused coolers.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:
10-15-80 — CMTL notified they rec'd samples for RJBL. SB asked CMTL to send samples to RJBL. -OK. Fed Express delivered them to SB by mistake. New C of C started & then sent to RJBL 10-15-80 by SB.

Informed Fed Exp. of the problem.

CA Initially Approved By: Date:

Follow-up Dates

Final CA Approval By: RME Date: 1/30/81 Problem Solved

Information copies to:
RESPONSIBLE PERSON: S.Diamond
QA MANAGER: RMEllersick
DEPARTMENT MANAGER: R. Broadway

Corrective Action Request Form No. LC-1-619-026-013

Originator R. M. ELLERSICK Date 2/2/81

Person Responsible for Replying S. DIAMOND Contract Involved LC 1-619-026

Description of problem and when identified: One analyses tag number assigned to two different collected samples of groundwater for volatile organics in two cases.

W 21773 assigned to Well 84A and Well 84B

W 21778 " " " " " "

Samples collected on 10/14/80.

State cause of problem, if known or suspected: Mistake by Sample Bank; found by Sample Bank.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10/15/80 S.D. Check with Anal Lab (CompuChem/Mead) to establish which samples were analyzed by lab. See attached memo.

CA Initially Approved By: ______ Date: ______

Follow-up Dates ______

Final CA Approval By: RME Date: 2/2/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: ______

QA MANAGER: ______

DEPARTMENT MANAGER: ______

LC-1-619-026-013

GCA
Technology Division

Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To: Mary Havalock

Date: 12 December 1980

From: Stephanie Diamond

Subject: WATER SAMPLES W21773 and W21778
LOVE CANAL STUDY

When the volatiles from wells 84A and 84B were processed through the Sample Bank, a mix-up occurred. W21773 was assigned to Sample Tags #22237 (Well 84A) and #22243 (Well 84B). W21778 was assigned to Sample Tags #22238 (Well 84A) and #22244 (Well 84B).

Kevin McConnaghy of CMTL was contacted to find out which samples had been analyzed. It was determined by analytical tag nos. and jar nos. that well 84A had been analyzed in each case. No volatile analysis on Well 84B will be coming from CMTL.

ST/mm

cc: R. M. Ellersick ✓

Corrective Action Request Form No. LC-1-619-026-014

Originator SADiamond Date 1-30-81

Person Responsible for Replying ______ Contract Involved 1-619-026

Description of problem and when identified: Different conc assigned the tenax QC samples and the information was picked up by the SB till a later date

State cause of problem, if known or suspected: SB did not check the PEI concs before sending out each batch.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10-22-80 SADiamond called BCL - they had used PEI-7 w/old conc and also part of PEI-8. The new conc were given over the phone & hard copy sent later. PEDCo was contacted and had not used any of the QC w/new concs - hard copy sent.

PEI-1 thru PEI-6 one set of conc.
PEI-7 thru PEI-12 another set of concs.

CA Initially Approved By: SAD Date: 10/22/80

Follow-up Dates ______

Final CA Approval By: RME Date: 2/18/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: SADiamond

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: RBradway

Corrective Action Request Form No. LC-1-619-026-015

Originator SADiamond

Date 1-30-81

Person Responsible for Replying SADiamond

Contract Involved 1-619-026

Description of problem and when identified:

W21725 analyzed as semivol
W21726 analyzed as pest
12-2-80

State cause of problem, if known or suspected: US EPA - EMSL - Cinn lab incorrectly analyzed the samples.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

- W21725 should have been a pest
- W21726 should have been a semi-vol.

12-2-80 - the log book was changed to show the above information.

CA Initially Approved By: SAD

Date: 12/2/80

Follow-up Dates

Final CA Approval By: RME

Date: 2/15/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: SADiamond

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: R. Bradway

Custody Record CA Forms

Corrective Action Request Form No. LC-1-619-026-016

Originator R.M. ELLERSICK

Date 2/3/81

Person Responsible for Replying S. DIAMOND

Contract Involved LC 1-619-026

Description of problem and when identified: Hi Vol QC samples received at Sample bank without custody records; identified on receipt ≅ 8/15/80

State cause of problem, if known or suspected: oversight

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

8/20 S. Diamond called NEIC (Dick Warner) for recommendation on solving problem.

8/28 RME followed through on Dick Warner's recommendation sending attached letter to Jack Puzak with custody forms.

9/30 RME – Call to Jack Puzak. Stephanie has not rec'd C of C forms yet. He'll send out.

≅ 10/15 RME – Checked with S. Diamond. Custody forms had been received.

CA Initially Approved By: RME

Date: 8/20/80

Follow-up Dates 9/30/80

Final CA Approval By: RME

Date: 2/3/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

LC 1-619-026-016

GCA

GCA CORPORATION
Technology Division

213 Burlington Road
Bedford, Massachusetts 01730
Telephone 617-275-5444
Telex 92-3339

28 August 1980

Mr. John Puzak (MD-77)
Quality Assurance Branch
U.S. EPA
EMSL - RTP
Research Triangle Park, NC 27711

Dear Jack:

Here are five Collection Media Custody Record sheets (Serial No's. 1099-1103), five QC Custody Record sheets (Serial No's. 6073-6077) and Sections 4 and 5 from the Love Canal Study draft QA Plan. Section 5.4 discusses use of the forms.

It should be possible to list the HiVols in bulk lots which contain consecutive numbers. My listing shows filter numbers 252499 through 25211 on one page and numbers 252396 through 252498 on another page; both pages are dated 8/7/80 and signed by Rita Zieger. There are occasional missing numbers or shifts in the number sequence used; if you feel you need more forms to list the unbroken lots of consecutive numbers, please contact Stephanie Diamond. She has the main supply of forms at the Sample Bank.

QC samples should be sent to her also with the true values and frequency to me at GCA in Bedford. They should be listed individually unless they are all the same. You can write in your identifying number in the section marked Tag No. Please don't put anything other than that identifying number on the sample container.

The address given is the GCA field office which is about five minutes away from the Sample Bank and has faster mail delivery. The phone number is the Sample Bank number and will enable you to speak with Stephanie directly. Thanks for your cooperation in getting these filled out.

Sincerely,

RoseMary Ellersick

RoseMary Ellersick
QA Manager

Ms. Stephanie Diamond
GCA Field Office
9712 Calvin Blvd.
Niagara Falls, NY 14304 Phone: 716-731-3005

cc: Stephanie Diamond

Corrective Action Request Form No. LC-1-619-026-017

Originator R.M. ELLERSICK Date 2/3/81

Person Responsible for Replying

Contract Involved LC 1-619-026

Description of problem and when identified: Disagreement between Sample I.D. numbers on custody forms and on analysis tags; found by ERCO on receipt of samples 8/26/80.

State cause of problem, if known or suspected: Incorrect numbering by Sample Bank personnel.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

8/26/80 K. Hausknecht/ERCO called RME to report on problem, then called S. Diamond to establish correct identity of samples.

8/28/80 RME called NEIC (Bob Harp) for recommendation and called K. Hausknecht to implement recommendation.

9/2/80 Attached letter received from K. Hausknecht following recommendation and solving problem.

2/3/81 RME checked Sample Bank Log Books to see that they agree with changes made to Custody forms. They do.

CA Initially Approved By: RME Date: 8/28/80

Follow-up Dates 2/3/81

Final CA Approval By: RME Date: 2/3/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

ERCO | Energy Resources Co. Inc.

185 Alewife Brook Parkway
Cambridge, Massachusetts 02138
(617) 661 3111   TWX 710 320 0721

Washington, D.C.
Houston, Texas
Torrance, California
La Jolla, California

Walnut Creek, California
Paris, France
Zurich, Switzerland

LC 1-619-026-017

August 29, 1980

Ms. Rosemary Ellersick
GCA Technology Division
GCA Corporation
Burlington Road
Bedford, MA 01730

Dear Rosemary:

Enclosed are two copies of the Chain-of-Custody records for the first set of Love Canal samples we have received. Several problems with identification were encountered and resolved. Sample W20065 was improperly marked as W20066 on the analytical tag; the correct number was determined by matching the actual tag numbers with sample numbers on file at the Sample Bank. Sample S40103 was improperly marked as S40104; the correct identification was ascertained by matching the sample numbers with the jar numbers. Sample W20073 was shipped as a separate sample on August 27, 1980, but is to be considered as part of the first set according to instructions from Sue Bianchetti. For water samples collected in polyethylene bottles, the record was changed to show that they are intended for fluoride and nitrate analysis, not metals.

Please call if you have any questions regarding these samples.

Sincerely,

Keith A. Hausknecht
Senior Scientist

KAH/glh
Enclosures

GCA copy S Diamond 9/2/80

An Equal Opportunity Employer M/F

Corrective Action Request Form No. LC-1-619-026-018

Originator S Diamond Date 1-29-81

Person Responsible for Replying S Diamond Contract Involved 1-619-026

Description of problem and when identified: A11852 - tenax sample sent w/out c of c to S Bromberg
Shippment arrived at CMTL ~~into~~ instead of US-EPA - RTP

State cause of problem, if known or suspected: SB Did not insert c of c document in with sample. Fed Exp delivered incorrectly

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10-15-80 Dexed c of c #6109 to S. Bromberg.
- Fed Exp picked up shippment & delivered to S. Bromberg

CA Initially Approved By: Date:

Follow-up Dates

Final CA Approval By: RME Date: 1/30/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: S Diamond

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: R. Bradway

Analytical CA Forms

Corrective Action Request Form No. LC-1-619-026-019

Originator R. M. ELLERSICK Date 2/10/81

Person Responsible for Replying R. M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Questionable conductivity results on groundwater samples reported on 15 September 1980 by AES laboratories.

State cause of problem, if known or suspected:

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10/3/80 RME Audited internal QC procedures for Love Canal analyses. See 10/15/80 Audit writeup. Requested AES to rerun conductivity, pH and TOC from series in question.

10/14/80 RME Called AES - markedly different conductivity values were found and the entire sample series was rerun.

10/31/80 Robert Wojcik/AES Submitted written analysis results for conductivity and TOC reruns. pH not rerun because holding time had been far exceeded. (TOC had been acidified.)

CA Initially Approved By: RME Date: 10/3/80

Follow-up Dates 10/14

Final CA Approval By: RME Date: 11/4/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-020

Originator R. M. ELLERSICK Date 2/5/81

Person Responsible for Replying K. T. McGREGOR Contract Involved LC 1-619-026

Description of problem and when identified: Questionable results on sump water samples analyzed for semivolatile organics by PJB laboratories — most compounds "not detected". Found when results reported ≅ 10/7/80. Also very low recovery on surrogates. Samples W20174, W20177, W20181.

State cause of problem, if known or suspected: Not known.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10/7/80 C. T. Hunt reviewed data, chromatograms submitted by PJB

10/8/80 C. T. Hunt and RME called PJB - spoke to David Ben Hur re these 3 samples and external QC generally. See attached 10/9/80 memo from C. T. Hunt. David Ben Hur stated he would provide internal QC info.

10/17/80 C. T. Hunt and K. T. McGregor with Drew Sauter (EPA-LV) audited PJB's Love Canal analytical work. Internal QC seemed deficient and Dr Ben Hur seemed unfamiliar with GC/MS analysis. PJB was required to send half of questionable sample

CA Initially Approved By: K. T. McGREGOR Date: 10/17/80

Follow-up Dates

Final CA Approval By: RME Date: 2/5/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Continued on next page

Corrective Action Request Form No. LC-1-619-026-020

Originator ______ Date (cont'd.)

Person Responsible for Replying ______ Contract Involved ______

Description of problem and when identified: ______

State cause of problem, if known or suspected: ______

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

extracts to CCA Laboratories and, after demonstrating capability on QC samples, to re-analyze the questionable samples' extracts. No further samples for semivolatile organics analysis were sent to PJB.

CA Initially Approved By: ______ Date: ______

Follow-up Dates ______

Final CA Approval By: ______ Date: ______

Information copies to:

RESPONSIBLE PERSON: ______

QA MANAGER: ______

DEPARTMENT MANAGER: ______

LC 1-619-026-020

GCA Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To: R.M. Bradway, K.T. McGregor

Date 10/9/80

From: G.T. Hunt

Subject PJB DATA PACKAGE

Dr. Drew Sauter (EMSL/Las Vegas) called on 10/7 to inquire about the recent data package from PJB (#23). His comments are summarized below:

- The total ion chromatogram for the three semi-volatiles samples appear to be very clean.
- The background profile appears to be very high, however, which could cause serious problems in component identification.
- No semi-volatile species are detect in the samples in question.
- The letter accompanying the data submittal is poorly written and technically suspect.
- Dr. Sauter suggested that PJB was having a potential problem with their capillary inlet system.
- He hoped that we had already looked into the suspect data problem.
- He further recommended that we send no further samples to PJB until this matter is resolved.

I proceeded to review the data package in question and noted the following:

- The surrogate compounds in each of the samples in question (W20177, W20181, W20174) were undetected. Anticipated concentrations were 25 µg/ℓ but were observed as 0 µg/ℓ.
- The total ion chromatogram backgrounds in several instances were quite high making compound identification difficult.
- The letter accompanying the data package was unclear. The English was not perfect, but still understandable, however.

I called Drew Sauter back and indicated that we are indeed reviewing this data and were presently investigating the matter.

I called Robert Bradway and informed him of what had happened to this point and he indicated that Rosemary Ellersick and myself call PJB to investigate.

We did so on 10/8/80, in the afternoon. Summarized on the next page are my notes from this conversation with Dr. Benhur of PJB:

LC-1-619-026-020

- He indicated that he experienced problems with the surrogates suggested for these samples. He, however, felt this was a problem inherent to the surrogates chosen.

- He indicated this his internal QC was fine. He, however, did not have any of this data available. He would get it to us, however.

- He noted that due to the complexity of the samples they were having problems finding the necessary ions to identify the semi-volatile species.

- He indicated that several people on his staff had experience with capillary columns and were instructing the others.

- He further indicated that his analytical detection limits were typically the order of 2-3 μg/ℓ.

- He would be interested in obtaining surrogate recoveries from other laboratories.

Based on my personal observations of the data and the above conversation I would like to make the following points:

- The reported surrogate recoveries are unacceptable for each of the three samples noted earlier.

- The detection limits quoted by PJB are not consistent with their other comments, e.g., if they could see 2-3 μg/ℓ why couldn't they detect even a 10% recovery of the surrogates (10% of 25 μg/ℓ).

- I am disturbed by Dr. Benhur's comment that they couldn't find the necessary ions to identify the said components.

- I am also disturbed by the comment concerning the complexity of each sample, yet the total ion chromatogram being relatively clean.

- I believe this matter warrants further investigation. Surrogate recovery data should be obtained from other contractors for comparison to PJB's results.

GTH:vmk
cc: B.M. Myatt
R.M. Ellersick ✓

Corrective Action Request Form No. LC-1-619-026-021

Originator R.M. ELLERSICK Date 2/18/81

Person Responsible for Replying R.M ELLERSICK

Contract Involved LC 1-619-026

Description of problem and when identified: Labs may not be following uniform extraction procedures for pesticide and semivolatile samples. Concern expressed by Bill Budde, EMSL/CINN on 10/9/80

State cause of problem, if known or suspected:

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10/9/80 B. Myatt and D. Chase checked with analytical subcontractors and found some differences existed.

10/9 - 10/9/80 RME checked Fed Reg procedures and discussed them with B. Budde to establish how to direct LC subcontractors. RME prepared and distributed 10/9/80 memo "Clarification of FR Method 608 and 625 Extraction Procedures.

CA Initially Approved By: R M Bralway Date: 10/9/80

Follow-up Dates

Final CA Approval By: RME Date: 10/9/80 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

LC-1-619-026-021

GCA Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To Analytical Subcontractor Laboratories
Love Canal Study 1-619-026

Date 9 October 1980

From R. M. Ellersick

Subject Clarification of Federal Register Method 608 and 625 Extraction Procedures

Both methods require extraction of the entire water sample and rinsing of the sample container with the methylene chloride to be used for extraction. Effective 8 October 1980, water samples for these analyses will be collected in one-quart containers providing approximately one liter for extraction. Prior to this date, water samples have been collected in both quart and gallon size containers.

A telephone check has indicated some discrepancies in the handling of these samples; Table 1 is intended to outline uniform procedures to be followed by all laboratories analyzing these samples. Laboratories should indicate on their data reporting Comments Form (J41) any departures from these procedures. Table 2 outlines the procedure to be followed to provide replicate analysis aliquots of every tenth sample - an internal QC requirement.

Each laboratory should notify me in writing of any samples already analyzed by Method 608 or 625 which were handled in a different manner from that described in this memo. The required information includes:

Sample number
Aliquot of total sample extracted
Total original sample volume
Volume of methylene chloride used
Rinsing or no rinsing of sample container

This information may be provided on the Comments Form (J41) for each sample or in a letter listing.

Please contact me with any questions you have relative to this matter.

RoseMary Ellersick

RoseMary Ellersick
QA Manager

RME/cf

cc: R. Bradway
W. Budde
D. Cogley
M. Havelock
G. Hunt
K. McGregor
B. Myatt
N. Pangaro
K. Wiltsee

LC-1-619-026-021

Table 1: Extraction Volumes for Different Size Samples (FR Methods 608,625)

Volume of total sample	1 liter	2 liters or larger
Size of separatory funnel	2 liter	4 or 6 liter
Volume of Methylene chloride		
1st extraction	60 ml	250 ml
2nd extraction	60	100
3rd extraction	60	100

If a laboratory has a two liter or larger water sample to be extracted and no appropriately-sized separatory funnel, aliquots of that sample may be serially extracted in the same two liter funnel with the same portion of methylene chloride. In this case, the larger volumes of methylene chloride are used (250,100,100). This is not a desirable procedure since it involves considerable sample transfer and the original sample container cannot be rinsed with fresh methylene chloride until all aliquots have had a first extraction. All transfer glassware used must also be rinsed with methylene chloride.

LC 1-614-026-021

Table 2: Replicate Analysis Aliquot Procedures (FR Methods 608,625)

Volume of total sample	1 liter	2 liters or larger
Volume of analysis replicates	500 ml	1 liter or larger
	(half the total sample volume)	
Volume of methylene chloride used for each replicate*		
1st extraction	30 ml	125 ml
2nd extraction	30 ml	50 ml
3rd extraction	30 ml	50 ml

*The volume of methylene chloride appropriate for the total sample volume is used. The sample is divided into two separatory funnels and the sample container is rinsed with the first extraction volume of methylene chloride (60 or 250 ml). The methylene chloride is then split between the two separatory funnels providing the extraction volumes listed above; this procedure is repeated with each fresh extraction volume of methylene chloride.

Corrective Action Request Form No. LC-1-619-026-022

Originator R.M. ELLERSICK

Date 2/23/81

Person Responsible for Replying

Contract Involved LC 1-619-026

Description of problem and when identified: Confusion about analytical method to use for Pesticide QC Check samples labeled 625-VO Pesticides. Identified in early October 1980 on questions from subcontractor laboratories.

State cause of problem, if known or suspected: QC Check Samples not originally designed for Love Canal work; instructions not customized for Love Canal Study.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10/8/80 RME - Prepared and sent memo to all subcontractor labs re QC Check sample handling and reporting generally.

10/24/80 RME - Prepared and sent memo to all subcontractor labs re Pesticide QC check samples specifically.

CA Initially Approved By: RME

Date: 10/5/80

Follow-up Dates 10/24/80

Final CA Approval By: RME

Date: 2/23/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

LC-1-619-026-022

GCA Technology Division

213 Burlington Road
Bedford Mass 01730
(617) 275-5444

To Analytical Subcontractors Love Canal Study LC 1-619-026 Date 8 October 1980

From R. M. Ellersick

Subject Clarification of Performance Evaluation and Quality Control Check Samples for Water, Soil and Sediment Samples.

Two different categories of known value water samples are being included in your sample shipments for QA/QC purposes. Both sample categories should be diluted as directed in their accompanying instructions and analyzed with Love Canal samples by the same analytical procedures as the Love Canal samples - even if those procedures differ from the instructions accompanying the Performance Evaluation or Quality Control Check Samples.

The information below summarizes the appropriate reporting of each category.

Performance Evaluation Samples

Frequency of use - approximately once a month.

Reporting time requirement - within 10 days of sample receipt by analytical laboratory.

Reporting format - use reporting form enclosed with P.E. sample.

Report submitted to both:

Quality Assurance Branch
Environmental Monitoring and Support Laboratory
U.S. Environmental Protection Agency
Cincinnati, OH 45268

Attn: John Winter

GCA/Technology Division
213 Burlington Road
Bedford, MA 01730

Attn: Diana Timlin
1-619-026

LC-1-619-026-022

WP Quality Control Check Samples

Frequency of use - One/batch collected samples. (Batch contains approximately 20 samples).

Reporting Format - use standard Love Canal data reporting forms (analyte concentration, internal QC and comments cards).

Report Submitted to: GCA/Technology Division
213 Burlington Road
Bedford, MA 01730

Attn: Diana Timlin
1-619-026

Please contact me if you have any further questions.

RoseMary Ellersick

RoseMary Ellersick
QA Manager

RME/cf

cc: R. M. Bradway
D. Cogley
S. Diamond
M. Havelock
K. McGregor
K. Wiltsee
J. Winter

LC-1-619-026-022

Memo dated 24 October 1980 to subcontractor labs is included with Corrective Action Form LC-1-619-026-025. The memo is on page C-45 of this report.

Corrective Action Request Form No. LC-1-619-026-023

Speed Letter®

From Ellersick

To McGregor

Subject

MESSAGE

Both Mead/Compuchem & SWRI's PE sample results are unacceptable. Corrective action has been initiated for both Labs.

Date 10/20/80 Signed

REPLY

Thanks for your notification. Please have your staff fill out a Corrective Action Form for each lab.

—No. 9 FOLD

—No. 10 FOLD

Date 10/21/80 Signed RME

GRAYLINE FORM 44-902 3 PART
LITTON OFFICE PRODUCTS CENTERS BOSTON, MASS. 02111

RECIPIENT—RETAIN WHITE COPY, RETURN PINK COPY.
TURN OVER FOR USE WITH WINDOW ENVELOPE.

Corrective Action Request Form No. LC-1-619-026-024

Originator R.M. ELLERSICK Date 2/23/81

Person Responsible for Replying R.M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Inappropriate correction of TOX results for percent recovery of standard; found by RME on 12/9/80 when preparing TOX writeup for Love Canal QA Plan. AES Laboratories

State cause of problem, if known or suspected: Lack of experience with TOX analyzer

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

12/9/80 RME called Bob Wojcik /AES and asked him to check with Dohrmann, instrument manufacturer re appropriate correction.

12/10/80 Bob Wojcik - has checked. He will change the computer printout received from M. Havelock to accomplish the appropriate correction

≅ 1/6/81 RME - Followup with Mary Havelock - Has AES corrected TOX values by dividing by % recovery? Verbal reply by M.H. - Yes they have.

2/19/81 RME - Spot check of changes on computer printout. Values corrected back to original uncorrected values. Call to Bob. Wojcik by RME

CA Initially Approved By: RME Date: 12/10/80

Follow-up Dates ≅ 1/6/81, 2/19/81, 2/24/81

Final CA Approval By: RME Date: 2/24/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Continued on next page

Corrective Action Request Form No. LC-1-619-026-024

Originator ______ Date (cont'd.)

Person Responsible for Replying ______ Contract Involved ______

Description of problem and when identified: ______

State cause of problem, if known or suspected: ______

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

2/23/81 RME - Spot check of Table of Corrected TOX values submitted by Bob Wojcik on 2/20/81 shows Scattered errors, questions on roundoff and significant figure use. Call to B. Wojcik.

2/24/81 Bob Wojcik - Called RME and resolved questions raised on 2/23/81. RME submitted corrected table to M. Havelock for use in changing verified data. RME sent letter with changed Table included to B. Wojcik.

CA Initially Approved By: ______ Date: ______

Follow-up Dates ______

Final CA Approval By: ______ Date: ______

Information copies to:

RESPONSIBLE PERSON: ______

QA MANAGER: ______

DEPARTMENT MANAGER: ______

QC Check Samples/Data Handling
CA Forms

Corrective Action Request Form No. LC-1-619-026-025

Originator BMyatt Date 10/15/80

Person Responsible
for Replying E. McGovern, SWRI Contract Involved 1-619-026

Description of problem and when identified: Rm Bradway/M. Havelock received "confirmed" data from SWRI (10/15/80) with changes, not keypunch errors, made to original data provided. It was requested that the originator contact Ed McGovern of SWRI to determine why such changes were made.

State cause of problem, if known or suspected: McGovern responded that errors in mathematical calculations and transcription errors of data to coding forms were made in original submission.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

10/20/80 - BMyatt to draft letter to SWRI requesting that data be checked prior to initial submission to GCA.
RMEllersick to review and send to SWRI.
10/21/80 - BMyatt drafted letter to all subcontractors to clarify PE sample analytical methods (especially pesticides). This letter also includes a request that they double-check all data before initial submission. This letter will be sufficient for purposes of urging SWRI to check data before coding.
RMEllersick to review and send letter to subcontractors.
Letter sent 10/24/80 by RME

CA Initially Approved By: RME Date: 10/20/80

Follow-up Dates

Final CA Approval By: RME Date: 10/24/80 Corrective Action Taken

Information copies to:

RESPONSIBLE PERSON: BMyatt

QA MANAGER: RMEllersick

DEPARTMENT MANAGER: KTMcGregor

PROJECT MANAGER RM Bradway

LC-1-619-026-025

GCA Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To: Analytical Subcontractors Love Canal Study
LC 1-619-026

Date: 24 October 1980

From: R. M. Ellersick

Subject: Laboratory Data Review/Pesticide Performance Evaluation and Quality Control Check Samples

Laboratory Data Review

Recent verification of raw data by the analytical subcontractors has shown the presence of both calculation and transcription errors. The internal QC procedures of each laboratory should include the checking of calculations and data entry before analytical results are reported to GCA. Please ensure that this is done in your laboratory.

Pesticide Performance Evaluation and Quality Control Check Samples

As stated in my 8 October 1980 memo, "Clarification of Performance Evaluation and Quality Control Check Samples for Water, Soil and Sediment Samples", both categories of known value water samples should be diluted as directed in their accompanying instructions and analyzed with Love Canal samples using the analytical procedures prescribed for Love Canal samples.

In the case of pesticides, this means:

- dilute sample as in instructions
- extract using Method 608 procedures
- analyze by Method 608 (GC/EC) and confirm by Method 625 (GC/MS)

Your cooperation in these matters is appreciated; please contact me if you have any questions.

RoseMary Ellersick

RoseMary Ellersick
QA Manager

cc: R. Bradway
D. Cogley
S. Diamond
M. Havelock
K. McGregor
B. Myatt
K. Wiltsee

Corrective Action Request Form No. LC-1-619-026-026

Originator R.M. ELLERSICK Date 2/25/81

Person Responsible for Replying R.M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Nitrate results on QC Check Samples and PE samples are not consistently reported by subcontractor labs. Found 11/10/80 when discussing questionable QC sample results on W25542 - W25546 with ERCO. Sample W25973 also involved.

State cause of problem, if known or suspected: EPA True Values are calculated as nitrogen and listed as NO_3-N. Love Canal coding manual requires calculation as NO_3.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

11/10/80 RME - Called ERCO to check on their calculation procedure.

1/10/81 RME - Other QC Check Sample reporting for nitrate was inconsistent. Discussed best way to handle with Mary Havelock.

1/12/81 RME - converted EPA's True Values to NO_3 basis and checked all QC Check Sample reports to ensure contractors had reported on NO_3 basis. RME changed any reported values as needed. Memo to this effect to M. Havelock 1/12/81

CA Initially Approved By: RME Date: 11/10/81

Follow-up Dates 1/12/81

Final CA Approval By: RME Date: 1/12/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

GCA Technology Division

LC-1-619-026-026

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To M.C. Havelock

Date 1/12/81

From R.M. Ellersick RME

Subject Love Canal Study LC 1-619-026
Fluoride/Nitrate QC Samples

EPA reports the True Values for QC Check Samples containing nitrate as Nitrate-N which means that the nitrate concentration present has been converted to the equivalent amount of nitrogen before reporting. The subcontractor laboratories have not been fully consistent in the way they have reported the nitrate concentration found in QC samples.

To clarify the situation and make the QC samples more directly comparable with collected samples (all of which have the nitrate found reported as nitrate), we should encode QC sample results calculated as nitrate. The table below shows the change in True Values required to do this; the values on the right (Nitrate) should be used. I have made these changes on coding forms which I have checked.

Since I have checked and corrected data report forms and coding forms for all fluoride/nitrate QC check samples sent to the subcontractors, there should be no problem with the observed or expected concentrations now. However, please check with me on any questions you have.

True Values* for Fluoride/Nitrate QC Samples

Ampule	Fluoride	Nitrate-N	Nitrate
Conc. 1	360	220	970
Conc. 2	2,300	10,100	44,700

*All values are given as micrograms/liter.

cc: K.T. McGregor
R.M. Bradway

Corrective Action Request Form No. LC-1-619-026-027

Originator R. M. ELLERSICK Date 12/31/80

Person Responsible for Replying R. M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Group of QC Check samples not acceptable as reported: 11/20/80
Samples W25536 – W25541 inclusive; ERCO metals

State cause of problem, if known or suspected: Suspected calculation or dilution problem

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

11/19/80 RME – Call ERCO (Keith Hausknecht) and ask him to check calculations and units used in reporting. No change.
11/19/80 RME – Call John Winter, EPA/Cinn, re True Values – no change. Harold Clements mentions different dilution instructions for these samples.
11/19/80 RME – Call Keith Hausknecht re dilution used. These samples diluted 10 ml concentrate → 1000 ml; should have been 10 ml concentrate → 100 ml.
11/20/80 RME – Issue memo giving True Values adjusted for different dilution. Copy attached.

CA Initially Approved By: RME Date: 11/19/80

Follow-up Dates

Final CA Approval By: RME Date: 11/20/80 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC 1-619-026-027

Originator ______ Date (cont'd.)

Person Responsible for Replying ______ Contract Involved ______

Description of problem and when identified: ______

State cause of problem, if known or suspected: ______

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

12/28/81 - Checked code sheets and verified data listings, Both show true values as listed on attached memo to M.C. Havelock from R.M. Ellersick. Also, comment card states that dilution values for expected concentrations were adjusted to match lab dilution. All 6 samples are O.K. (verified data listing of 1/12/81) - M.C.H.

CA Initially Approved By: ______ Date: ______

Follow-up Dates 12/28/81

Final CA Approval By: RME Date: 12/28/81 Correction Made + Verified

Information copies to:

RESPONSIBLE PERSON: ______

QA MANAGER: ______

DEPARTMENT MANAGER: ______

GCA
Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

Pkg #140

LC 1-619-026-027

To M. C. Havelock

Date 20 November 1980

From R. M. Ellersick RME

Subject Adjusted True Values for Listed QC Samples (ERCO)

True Values (adjusted for ERCO's dilution)

	Micrograms / liter
Antimony	———
Arsenic	182
Barium	———
Beryllium	261
Cadmium	59
Chromium	304
Copper	374
Lead	383
Nickel	165
Mercury	7.6
Selenium	48
Silver	———
Thallium	———
Zinc	478

——— indicates metal is not contained in this QC sample.

These adjusted True Values are to be used for the samples listed below:

Love Canal Study QC Check Samples

W 25536	(476 E, ICP, Conc. 2)
W 25537	(476 E, ICP, Conc. 2)
W 25538	(476 E, ICP, Conc. 2)
W 25539	(476 E, ICP, Conc. 2)
W 25540	(476 E, ICP, Conc. 2)
W 25541	(476 E, ICP, Conc. 2)

cc: K.T. McGregor

Corrective Action Request Form No. LC 1-619-026-028

Originator R. M. ELLERSICK Date 3/3/81

Person Responsible for Replying R. M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Confusion in identity of metals QC samples; found 12/4/80 by RME when verifying QC sample results. Samples W21087-W21089, W25003 / ERCO

State cause of problem, if known or suspected: Incorrect listing of sample type at LC Sample Bank suspected.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

12/4/80 RME - checked with Stephanie Diamond/CCA re problem. Results received from ERCO gave both Sample Bank number and QC sample vial identification. QC sample vial identification was in accord with analytical results and was accepted by RME.

12/4/80 S. Diamond corrected Sample bank log. RME provided M. Havelock/CCA with correct QC sample type for each number.

CA Initially Approved By: RME Date: 12/4/80

Follow-up Dates

Final CA Approval By: RME Date: 12/4/80 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-029

Originator R.M. ELLERSICK Date 2/25/81

Person Responsible for Replying R.M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Unreasonable results missing sample numbers on group of PE and QC Check Samples reported 12/1/80 by SWRI. Organics in H_2O, Soil QC Samples.

State cause of problem, if known or suspected:

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

12/5/80 RME Called Ed McGovern/SWRI with list of questions

12/8/80 Ed McGovern called RME and gave verbal explanation. He had found two different types of calculation errors and other problems.

12/9/80 Ed McGovern sent written copy of corrected results to RME with explanatory letter. RME provided copies to K.T. McGregor and M. Havelock after approving for data entry.

CA Initially Approved By: RME Date: 12/5/80

Follow-up Dates 12/15/80

Final CA Approval By: RME Date: 12/15/80 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-030

Originator R.M. ELLERSICK

Date 3/9/81

Person Responsible for Replying R.M. ELLERSICK

Contract Involved LC 1-619-026

Description of problem and when identified: QC Check Sample for Silver, Antimony and Thallium AA work may be inappropriate for Love Canal Study. Found when checking QC sample results for reasonableness - 12/10/80. PJB; 12/12/80 ERCO AA 379 Conc 1 and 2

State cause of problem, if known or suspected: Metal content may be too low to quantify by LC procedures; QC samples may be defective.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

12/10/80 RME called David Ben Hur / PJB Jacobs re conc. of standard used for Ag, Sb, Tl. Reply 1-10 μg/l

12/12/80 RME checks ERCO's reported DL 20-100 μg/l. Concentrate 2 is below these limits.

1/14/81 RME called Harold Clements / EPA Cinn to see if problems with these QC sample had been found. Harold reported no problems and good results from 200-300 labs in a methods study.

1/14/81 RME checked required DLs for LC water samples. Only Sb in Concentrate 2 is above these limits. QC samples seem inappropriate for LC work.

CA Initially Approved By: RME

Date: 12/10/80

Follow-up Dates 12/12/80, 1/14/81

Final CA Approval By: RME

Date: 3/9/81 Problem Explained

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-031

Originator R.M. ELLERSICK Date 2/25/81

Person Responsible for Replying R.M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Questionable results on Pesticides and Purgeables QC Check Samples; found 12/10/80 when checking results. PJB Labs Samples S 50315, S 30314

State cause of problem, if known or suspected: Calculation or dilution error suspected.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

12/10/80 RME Called David Ben-Hur / PJB re above.
12/11/80 David Ben-Hur called RME – reported he found concentrate dilution error in sample S50314 and standard dilution error in sample S50315. He submitted written corrected results.
12/15/80 Corrected written results to M. Havelock for data entry.

CA Initially Approved By: RME Date: 12/10/80

Follow-up Dates

Final CA Approval By: RME Date: 12/15/80 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-032

Originator R.M. ELLERSICK

Date 12/29/80

Person Responsible for Replying R.M. ELLERSICK

Contract Involved LC 1-619-026

Description of problem and when identified: Changes to reported results on P-E Samples; found when questioning "not acceptable" entries on EPA/EMSL/CINN Report. Samples W25994 - W26000 PTB/Jacobs Eng.

State cause of problem, if known or suspected:

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

12/29/80 RME Entered verbal corrections received from David Ben Hur on EPA report form copies and gave them to M. Havelock for data entry. Requested PTB send written confirmation of changes to me and EPA/Cinn.

1/20/81 RME - No written corrections received. Call to D. Ben Hur; he has sent them to GCA and EPA. Will Telex them to me again.

1/22/81 RME - Call John Winter, EPA/Cinn to see if written changes received there. Spoke to Harold Clements on 1/27/81. Changes were received there in writing on 1/5/81.

CA Initially Approved By: RME

Date: 12/29/80

Follow-up Dates 1/20/81, 1/22/81 1/27/81

Final CA Approval By: RME

Date: 1/27/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-033

Originator R.M. ELLERSICK Date 1/6/81

Person Responsible for Replying M.C. HAVELOCK Contract Involved LC 1-619-026

Description of problem and when identified: All reported results for 1,2,3,4-tetrachlorobenzene on external polyurethane foam QC samples are high by a factor of 2-3. Found by A. Lafleur when checking coding forms and comparing reported results with known values (1/2/81).

State cause of problem, if known or suspected: These results may have been multiplied by a factor of 2.5 to correct for collection efficiency of tetrachlorobenzene on foam.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

1/5/81 - RME - Check with B.M. Myatt re instructions to analytical subcontractors. She reports that the subcontractors report concentrations as found and the CCA computer program applies the collection efficiency factor.

1/5/81 - RME - Check with M.C. Havelock re application of factor to these results. Reported results for tetrachlorobenzene have been multiplied by 2.5 before they were recorded on coding forms.

1/5/81 - RME - Check with R.R. Watts and/or M.D. Jackson re use of 2.5 factor on QC samples. All concur that it should not be used. Memo to M.C. Havelock to correct.

CA Initially Approved By: RME Date: 1/6/81

Follow-up Dates 1/15/81 1/21/81 - Verified data printout correct.

Final CA Approval By: RME Date: 1/21/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: M.C. HAVELOCK, R.M. BRADWAY, K.T. McGREGOR

QA MANAGER: R.M. ELLERSICK

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-034

Originator R.M. ELLERSICK Date 1/6/81

Person Responsible for Replying R.M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Large discrepancy (≅ tenfold) between analytical results and known values for HiVol QC filter strips; found when checking coding forms for these samples.

State cause of problem, if known or suspected: Suspected calculation error, or reporting results on basis of whole filter; True values are given for strip.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

1/6/81 - RME - Check with John Puzak (EPA-RTP) re calculation and reporting basis used by lab. Jack reports that lab multiplied concentrations found on the QC filter strip by 12 to report results for whole filter.

1/6/81 - RME - Memo to Mary Havelock requesting that known values be multiplied by 12 for comparison with the analytical results.

1/7/81 - Check of coding forms containing known values and reported results shows corrective action accomplished.

CA Initially Approved By: RME Date: 1/6/81

Follow-up Dates

Final CA Approval By: RME Date: 1/7/81

Information copies to:

RESPONSIBLE PERSON: M.C. HAVELOCK, K.T. McGREGOR, R.M. BRADWAY

QA MANAGER: R.M. ELLERSICK

DEPARTMENT MANAGER:

LC-1-619-026-034

GCA Technology Division

213 Burlington Road
Bedford, Mass. 01730
(617) 275-5444

To: M. C. Havelock

Date: 6 January 1981

From: R. M. Ellersick RME

Subject: Love Canal Study LC 1-619-026
Hi Vol QC Samples

The laboratory analyzing Hi Vol filters has reported the metal content on QC filter strips as micrograms per whole filter. To compare these observed concentrations with the known values, the known values on the attached sheet should be multiplied by 12 to give known values on the whole filter. No Total Suspended Particulate (TSP) values are to be reported on QC samples.

RME/cf

cc: J. Puzak, EPA/RTP
R. M. Bradway, GCA
K. T. McGregor, GCA

TRACE METAL STRIPS LC-1-619-026-034

UG/STRIP

S/N	DEP (mg)	BA	CD	CO	CU	FE	MN	NI	SR	V	ZN
1007	45.80	211.4	103.2	150.5	155.3	908.0	296.7	36.2	151.1	86.3	38.7
1046	49.16	226.9	110.8	161.5	166.7	974.6	318.5	38.9	162.2	92.6	41.6
2089	49.70	331.9	86.2	33.5	720.4	405.9	66.1	159.9	33.6	160.8	668.5
2106	44.70	298.5	77.5	30.1	647.9	365.0	59.4	159.9	30.3	160.8	601.3
3005	47.83	77.4	26.8	93.7	391.9	1577.1	184.8	94.3	94.1	35.8	311.7
3027	51.23	82.9	28.7	100.4	419.7	1689.3	197.9	101.0	100.8	38.4	333.9

	SERIES 1000*	SERIES 2000	SERIES 3000
As	70.5	19.7	120.6
Pb	796.2	446.2	99.5

*Series # matches first digit of S/N

Corrective Action Request Form No. LC-1-619-026-035

Originator R.M. ELLERSICK Date 1/7/81

Person Responsible
for Replying Contract
Involved LC 1-619-026

Description of problem and when identified: Two different sets of analytical results reported by Acurex for some QC Check samples; found when verifying coding of QC Check samples. Samples W25950-W25954, S40925, S40926, S40929

State cause of problem, if known or suspected: Suspected that Pesticide QC samples (all, except S40929) were first run by FR Method 625 and reported and later run by Method 608 + reported.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

1/7/81 RME - Check with M.C. Havelock for further background. Mary has no info on why two sets of results exist.

1/7/81 RME - Check with Acurex. Bill Fitch/Acurex reports that Acurex reported as "Trace" all compounds that were positively identified but at a concentration < 1 ug/l or/ < 1 mg/kg. This resulted in several compounds in QC samples being reported as "Trace". On request from ECA, Acurex submitted second set of results giving quantitative results for QC samples.

1/7/81 RME Reviewed second set of results and OK'd them for entry into data management system. First set to be deleted.

CA Initially Approved By: RME Date: 1/7/81

Follow-up Dates 1/20/81

Final CA Approval By: RME Date: 12/28/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: M.C. HAVELOCK, R.T. McGREGOR, R.M. BRADWAY

QA MANAGER: R.M. ELLERSICK

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-035

Originator ______________________ Date (cont'd.)

Person Responsible for Replying ______________________ Contract Involved ______________________

Description of problem and when identified:

State cause of problem, if known or suspected:

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

1/21/81 RME Check verified data file to be sure that quantified results have replaced "Trace". Samples W25950 - W25954 S40929 have quantified results entered and show "C" on line to indicate correction. Samples S40925, S40926 not processed yet.

See CA Form No.

12/28/81 M.C.H. Checked verified data listings (2/9/81). "A4" cards for reporting obs. and expected concentrations correct for both samples. "A1" cards (obs. conc. only) all correct for S40924. For S40926, all "A1" cards correctly changed, except for Dieldrin, which still reads "TRACE". M.C.H.

CA Initially Approved By: ______________________ Date: ______________________

Follow-up Dates 1/26/81, 12/28/81

Final CA Approval By: ______________________ Date: ______________________

Information copies to:

RESPONSIBLE PERSON: ______________________

QA MANAGER: ______________________

DEPARTMENT MANAGER: ______________________

Corrective Action Request Form No. LC-1-619-026-036

Originator L.M. EILERSICK

Date 1/21/81

Person Responsible for Replying M.C. HAVELOCK

Contract Involved LC 1-619-026

Description of problem and when identified: Follow-up check on correction of "Trace" reporting on QC samples by Acurex showed that changes made by Acurex to raw data printouts were not entered into verified data file for samples W25950, W25952.

State cause of problem, if known or suspected: More than one set of verification changes prepared; sample verified with only one set.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

Sample ID #s have been placed on list of verified samples with known errors. Time and mechanism for correcting errors have not yet been determined. Samples cited above will be part of general decision
MCH 1/22

a. Errata list has been submitted to Lawless 1/27-1/29. He will make corrections to EPA's verified and validated data bases.
b. We are correcting our verified data base for known errors. Samples W25950 and W25952 are included in these two correction procedures — MCH 2/3/81

12/28/81 - MCH checked VERFIF folder of corrected verified samples — W2590 and W2592 are correctly listed in VERFIX #1, of 2/11/81 · M.C.H.

CA Initially Approved By: LME Date: 1/22/81

Follow-up Dates 2/3, 12/28/81

Final CA Approval By: LME Date: 12/28/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-037

Originator R.M. ELLERSICK

Date 1/9/81

Person Responsible for Replying S. DIAMOND

Contract Involved L.C. 1-619-026

Description of problem and when identified: Arochlor 1242 reported in a QC sample not containing Arochlor 1242. Found when checking QC sample results for reasonableness. Sample S40412 /CSRI

State cause of problem, if known or suspected:

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

1/6/81 RME - Call to Roger Novak / CSRI. Roger states that Sample S40412 was received broken. CSRI replaced it with an EPA QC sample from the same series which contained Arochlor 1242 and reported this as sample S40412.

1/6/81 - RME - Requested S. Diamond to note this change in Sample Master Log.

2/2/81 - RME - Checked Soil Master Log - no notation of broken sample. Requested S. Bianchetti to note this. Comment entered in data base re substitution by lab.

CA Initially Approved By: RME

Date: 1/6 81

Follow-up Dates ~~1/12/81~~ 2/2/81

Final CA Approval By: RME

Date: 2/2/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON: S. DIAMOND, K.T. McGREGOR, R.M. BRADWAY

QA MANAGER: R.M. ELLERSICK

DEPARTMENT MANAGER:

Corrective Action Request Form No. LC-1-619-026-038

Originator R.M. ELLERSICK Date 3/9/81

Person Responsible for Replying R.M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: Phenol QC Check Sample may not be appropriate for Love Canal Study. Found when checking QC sample results for reasonableness in Dec '80 and Jan '81. Samples S50317, S40924, W25955 – W25959 @ Acurex.

State cause of problem, if known or suspected: Phenol content may be too low to quantify by LC procedures; QC samples may not contain phenol – may be defective.

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

1/7/81 RME Checked with Bill Fitch/Acurex re no quantified phenol results on samples listed above. Bill stated that they injected one concentrate neat and found no phenol; they never found any phenol in these QC samples – detection limit was ≅ 5 µg/l for water samples.

1/7/81 RME discussed problem with Gary Hunt/GCA.

1/8, 1/12/81 RME discussed problem with Harold Clements/EPA. EPA has gotten reasonable results from 3 outside labs on these samples; will check them in-house.

1/16/81 H. Clements QC samples verified by EPA/Cin.

1/14/81 RME – Entered comment "May be inappropriate QC sample".

CA Initially Approved By: RME Date: 1/7/81

Follow-up Dates 1/14/81, 1/16/81

Final CA Approval By: RME Date: 3/9/81 Problem Explained

Information copies to:

RESPONSIBLE PERSON: ________

QA MANAGER: ________

DEPARTMENT MANAGER: ________

Corrective Action Request Form No. LC-1-619-026-039

Originator R.M. ELLERSICK Date 2/5/81

Person Responsible for Replying R.M. ELLERSICK Contract Involved LC 1-619-026

Description of problem and when identified: DDT results on QC Check Samples were 2-3 times the true value; dieldrin was reported as not detected although present in the QC sample. Samples W25935-W25938 sent to Compuchem/Mead.

State cause of problem, if known or suspected: not known

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

2/3/81 RME discussed with Gary Hunt the reasonableness of these results. Gary stated that dieldrin might coelute with DDE but a Florisil column should resolve them; the DDT results did not seem reasonable to him and should be questioned.

2/3/81 RME called Kevin McConnaghy/Acurex and asked him to check DDT and dieldrin on these samples. Patty Ragsdale/Compuchem called on 2/5/81 and stated that their columns did not resolve dieldrin and DDE and they reported the single peak as DDE. She is still checking on the DDT results. (See next page.)

CA Initially Approved By: RME Date: 2/3/81

Follow-up Dates 2/12, 2/13, 2/19

Final CA Approval By: Date:

Information copies to:

RESPONSIBLE PERSON: R.M. ELLERSICK

QA MANAGER:

DEPARTMENT MANAGER: K.T. McGREGOR, R.M. BRADWAY, C.T. HUNT

Corrective Action Request Form No. LC-1-619-026-039

Originator

Date (cont'd.)

Person Responsible for Replying

Contract Involved LC 1-619-026

Description of problem and when identified:

State cause of problem, if known or suspected:

Sequence of Corrective Action: (If no responsible person is identified, bring this form directly to QA Manager.)

State Date, Person, and Action Planned:

2/19/81 RME - Letter containing amended DDT results rec'd. Checked with P. Ragsdale - some results changed due to calculation errors or incorrect identification. Amended values for these are still based on original analysis which was confirmed by reanalysis of extract. QC check sample results - amended values are reanalysis values. No apparent problems found with original data.

2/23/81 RME - discussed QC check sample reanalysis with K.T. McGregor, R.M. Brodway. Original analysis values will be entered with comment "Extract Reanalyzed" and amended value given.

CA Initially Approved By: Date:

Follow-up Dates

Final CA Approval By: RME Date: 2/23/81 Problem Solved

Information copies to:

RESPONSIBLE PERSON:

QA MANAGER:

DEPARTMENT MANAGER:

APPENDIX D

MISCELLANEOUS SUPPORTING INFORMATION

	Page
Glossary of Compound Classes	D-2
Correspondence Concerning QA Plans	D-11
Examples of Laboratory Control Charts	D-18

GLOSSARY OF COMPOUND CLASSES

Several of the terms used to describe pollutant classes measured in the Love Canal Study have no precise definition outside of this measurement program. This glossary is provided to define the terms as used in this document. The complete compound/element lists are also given because they do not simply correlate to the Method 624, 625, etc. analyte lists but have been amended to include compounds suspected to be present in the Love Canal area. It should be noted that the hitlists for organic compounds in air are not the same as those for the other media and that they include compounds both for quantitative and qualitative analyses.

AIR MEDIUM

Volatiles on Tenax

The compounds listed in Table D-1 are measured by GC/MS using a thermal desorbtion method for analysis. Compounds contained in the air are adsorbed onto Tenax-GC resin as the air sample is passed through the cartridge, or trap, as the sampling device is called. The analytical procedure calls for thermally desorbing the compounds from the resin, cryogenically trapping them, and injecting the sample onto a capillary column for GC/MS analysis.

Pesticides and Related Compounds on Polyurethane Foam Plugs (PUFs)

These compounds are frequently referred to only as pesticides, but the actual compound list differs significantly from pesticides in other media and should not be confused with that group of compounds. The PUFs hitlist is given in Table D-2 and includes compounds for both quantitative and qualitative measurement as indicated. These samples were analyzed by extracting each PUF with 5 percent ether in hexane. Chlorinated phenols were analyzed by electron capture gas chromatography (EC-GC) or high pressure liquid chromatography (HPLC) without preliminary cleanup of the extract. Chlorinated pesticides and PCBs were analyzed by EC-GC after column chromatographic cleanup of the extract.

Metals on Hi-Vol Filters

The metals on hi-vol filters were acid extracted and then analyzed by inductively coupled argon plasma spectrometry (ICP) and/or by neutron activation analysis (NAA). The hitlist for inorganic substances measured in the Love Canal Study is given in Table D-3. Note that the anions fluoride and nitrate were measured only in water samples.

TABLE D-1. VOLATILE ORGANIC COMPOUNDS ON TENAX

Quantitative analysis	Qualitative analysis
Benzene	Chloroform
Carbon tetrachloride	1,2-Dichloroethane
Chlorobenzene	2,4-Dichlorotoluene
o-Chlorotoluene	o-Chlorobenzaldehyde
p-Chlorotoluene	p-Chlorobenzaldehyde
1,2-Dibromoethane	Benzyl Chloride (α-chlorotoluene)
o-Dichlorobenzene	1,1-Dichloroethane
p-Dichlorobenzene	1,1-Dichloroethylene (vinylidene chloride)
1,1,2,2-Tetrachloroethylene	1,2-Dichloroethylene
Toluene	Dichloromethane
	Phenol
	o-Xylene
	m-Xylene
	p-Xylene

TABLE D-2. PESTICIDES AND RELATED COMPOUNDS ON POLYURETHANE FOAM PLUGS (PUFs)

Quantitative analysis	Qualitative analysis
Lindane	Hexachloro-1,3-butadiene
Hexachlorobenzene	1,2,4,5-Tetrachlorobenzene
Hexachlorocyclopentadiene	α,α,2,6-Tetrachlorotoluene
1,2,3,4-Tetrachlorobenzene	Pentachloro-1,3-butadiene
1,2,3-Trichlorobenzene	Pentachloronitrobenzene
1,2,4-Trichlorobenzene	1,2,3,5-Tetrachlorobenzene
1,3,5-Trichlorobenzene	α-Benzenehexachloride (-BHC)
2,4,5-Trichlorophenol	Heptachlor
Pentachlorobenzene	

TABLE D-3. CHEMICALS TO BE MONITORED IN LOVE CANAL-- WATER, SOIL, SEDIMENT AND BIOTA SAMPLES

Compound, Element, or Ion	CAS registry number
Volatiles	
methylene chloride	75-09-2
chloromethane	74-87-3
1,1-dichloroethene	75-35-4
bromomethane	74-83-9
1,1-dichloroethane	75-34-3
vinyl chloride	75-01-4
cis-1,2-dichloroethene	156-59-2
chloroethane	75-00-3
trans -1,2-dichloroethene	156-60-5
trichlorofluoromethane	75-69-4
chloroform	67-66-3
1,2-dichloroethane	107-06-2
1,1,1-trichloroethane	71-55-6
carbon tetrachloride	56-23-5
bromochloromethane	74-97-5
bromodichloromethane	75-27-4
2,3-dichloropropene[1]	78-88-6
1,2-dichloropropane	78-87-5
trichloroethene	79-01-6
trans -1,3-dichloropropene	10061-02-6
benzene	71-43-2
acrolein[1]	107-02-8
acrylonitrile[1]	107-13-1
dibromochloromethane	124-48-1
1,1,2-trichloroethane	79-00-5
bromoform	75-25-2
1,1,2,2-tetrachloroethane	79-34-5
benzyl chloride	100-44-7
o-xylene	95-47-6
m-xylene	108-38-3
p-xylene	106-42-3
tetrachloroethene	127-18-4
toluene	108-88-3
2-chlorotoluene	95-49-8
3-chlorotoluene	108-41-8
4-chlorotoluene	106-43-4
chlorobenzene	108-90-7
ethyl benzene	100-41-4
1,2-dibromoethane	106-93-4

(continued)

TABLE D-3 (continued)

Compound, Element, or Ion	CAS registry number
Semi-volatiles	
hexachloroethane	67-72-1
1,4-dichlorobenzene	106-46-7
1,3-dichlorobenzene	541-73-1
1,2-dichlorobenzene	95-50-1
bis(2-chloroethyl)ether	111-44-4
bis(2-chloroisopropyl)ether	39638-32-9
N-nitrosodi-n-propylamine	621-64-7
hexachlorobutadiene	87-68-3
1,2,3-trichlorobenzene	87-61-5
N-nitrosodimethylamine[2]	62-75-9
1,2,4-trichlorobenzene	120-82-1
1,3,5-trichlorobenzene	108-70-3
nitrobenzene	98-95-3
naphthalene	91-20-3
isophorone	78-59-1
bis(2-chloroethoxy)methane	111-91-1
hexachlorocyclopentadiene[3]	77-47-4
2-chloronaphthalene	91-58-7
acenaphthylene	208-96-8
acenaphthene	83-32-9
dimethylphthalate	131-11-3
2,6-dinitrotoluene	606-20-2
fluorene	86-73-7
1,2-diphenylhydrazine[4]	122-66-7
4-chlorophenylphenyl ether	7005-72-3
2,4-dinitrotoluene	121-14-2
2,4-dichlorotoluene	95-73-8
diethylphthalate	84-66-2
N-nitrosodiphenylamine[5]	86-30-6
hexachlorobenzene	118-74-1
4-bromophenylphenylether	101-55-3
phenanthrene	85-01-8
anthracene	120-12-7
di-n-butyl phthalate	84-74-2
fluoranthene	206-44-0
pyrene	129-00-0
benzidine[6]	92-87-5
butylbenzylphthalate	85-68-7
di(2-ethylhexyl)phthalate	117-81-7
chrysene	218-01-9
di-n-octylphthalate	117-84-0
benzo(a)anthracene	56-55-3
benzo(k)fluoranthene	207-08-9
benzo(b)fluoranthene	205-99-2
benzo(a)pyrene	50-32-8

(continued)

TABLE D-3 (continued)

Compound, Element or Ion	CAS registry number
3,3-dichlorobenzidine	91-94-1
indeno(1,2,3-dc)pyrene	193-39-5
dibenzo(a,h)anthracene	53-70-3
benzo(g,h,i)perylene	191-24-2
pentachloronitrobenzene	82-68-8
2,4,6-trichloroaniline	634-93-5
4-chlorobenzotrifluoride (trifluoro-p-chlorotoluene)	98-56-6
1,2,3,4-tetrachlorobenzene	634-66-2
1,2,4.5-tetrachlorobenzene	95-94-3
2,3,7,8-tetrachlorodibenzo-p-dioxin (selected samples only)	1746-01-6
tetrachlorotoluenes (18 position isomers - ring and methyl substitution)	
2-chlorophenol	96-57-8
3-chlorophenol	108-43-0
4-chlorophenol	106-48-9
2-nitrophenol	88-75-5
phenol	108-95-2
2,4-dimethylphenol	105-67-9
2,4-dichlorophenol	120-83-2
2,3,6-trichlorophenol	933-75-5
2,4,6-trichlorophenol	88-06-2
4-chloro-3-methylphenol	59-50-7
2,4-dinitrophenol	51-28-5
2-methyl-4,6-dinitrophenol	534-52-1
pentachlorophenol	87-86-5
4-nitrophenol	100-02-7
Pesticides	
alpha-BHC[7]	319-84-6
beta-BHC	319-85-7
gamma-BHC[7]	58-89-9
delta-BHC	319-86-8
heptachlor	76-44-8
aldrin	309-00-2
mirex	2385-85-5
endosulfan I[7]	33213-65-9
heptachlor epoxide	1024-57-3
DDE	72-55-9
endrin[7]	72-20-8
endosulfan II[7]	959-98-8
dieldrin	60-57-1
endosulfan sulfate	1031-07-8
DDD	72-54-8

(continued)

TABLE D-3 (continued)

Compound, Element or Ion	CAS registry number
chlordane	57-74-9
DDT	50-29-3
toxaphene	8001-35-2
aroclor 1221	11104-28-2
aroclor 1254	11097-69-1
aroclor 1016	12674-11-2
aroclor 1232	11141-16-5
aroclor 1242	53469-21-9
aroclor 1248	12672-29-6
aroclor 1260	11096-82-5
Inorganics	
antimony	
arsenic	
barium	
beryllium	
cadmium	
chromium	
copper	
lead	
mercury	
nickel	
selenium	
silver	
thallium	
zinc	
fluoride } water samples only	
nitrate	

(continued)

TABLE D-3 (continued)

FOOTNOTES

1. These compounds may be observed to about 1 milligram per liter with Method 624. If detected the quantitative analysis must be accomplished by purging a second aliquot of the sample at 85°C as described in Method 603.

2. This compound is not resolved from the solvent with the standard columns required for Method 625. It may be resolved with a 30 meter fused silica SE 54 capillary column.

3. This compound decomposes in the injection port at the temperature required for Method 625. A second injection at a low injection port temperature is required to observe this compound when using the standard Method 625 columns. However, this compound is sufficiently stable for analysis with the 30 meter fused silica SE 54 capillary column.

4. This compound decomposes in the GC injection port to azobenzene, and cannot be distinguished from it by 70 ev mass spectrometry. If observed it must be reported as 1,2-diphenylhydrazine or azobenzene.

5. This compound decomposes in the GC injection port to diphenylamine, and cannot be distinguished from it by 70 ev mass spectrometry. If observed it must be reported as N-nitrosodiphenylamine or diphenylamine.

6. This compound is decomposed during the solvent concentration and drying steps of Method 625. It may be observed, but the concentration measurement cannot be considered reliable. It must be confirmed using an alternative method such as Method 605 (Federal Register, December 3, 1979).

7. These compounds are sensitive to the pH=12 extraction conditions of Method 625 and are not observed under normal conditions. These compounds must be measured using Method 608 with confirmation by GC/MS using the Method 608 extracts.

WATER AND SOIL/SEDIMENT MEDIA

Volatile Organics or Volatiles

Table D-3 lists the volatile organics, or purgeables, which were measured in water samples using Method 624 (FR Vol. 44, No. 233, Monday, December 3, 1979, pp. 69532-69539). A modification to Method 624 was needed to measure these compounds in soil and sediment samples. Note that Table D-3 is not simply the Method 624 hitlist but a list of compounds tailored to the Love Canal Study.

Semivolatile Organics or Semivolatiles

Table D-3 lists the compounds defined as semivolatiles for purposes of this program. They are generally the base/neutral and acid extractables of Method 625 (FR Vol. 44, No. 233, Monday, December 3, 1979, pp. 69540-69552), but the list also includes compounds of particular interest to the Love Canal Study. The analytical procedures for both water and soil/sediment samples required that the sample be extracted first at pH 11 and then at pH 2 with methylene chloride to extract base/neutral and acidic compounds, respectively. Soil and sediment extracts were subjected to column chromatography cleanup and then concentrated to 1 ml or 5 ml. Water sample extracts were concentrated without cleanup. Prior to GC/MS analysis using capillary column GC, an aliquot of the concentrated base/neutral extract was combined with an aliquot of the concentrated acid extract, and this combined extract was designated to be the sample.

Pesticides

Compounds designated as pesticides in this study are given in Table D-3. This is an amended list of the Method 608 analytes (FR Vol. 44, No. 233, Monday, December 3, 1979, pp. 69501-69509) and includes pesticide and PCB compounds of interest to the Love Canal Study. Extraction and preparation procedures were specified for water, soil and sediment samples. Analysis of the concentrated extracts was performed using electron capture detector gas chromatography (EC-GC) and confirmation of identified species was made using GC/MS when appropriate concentration levels were found.

Metals

The Love Canal Monitoring List included 14 elements (metals) as previously listed in Table D-3. These same metals were analyzed in all media. Water samples were analyzed for metals after acid digestion to ensure measurement of total metals. ICP and/or AAS were used for water analyses. Soil and sediment samples were also subjected to acid digestion and the extract analyzed by AAS. ICP was not used in the analysis of soil or sediment samples.

BIOLOGICAL MATERIALS (BIOTA) MEDIUM

Volatile Organics in Foodstuffs

The volatiles in foodstuffs consisted of the same compounds on the hitlists for volatiles in water, soil and sediment. However, rather than using the purge-and-trap GC/MS Method for analysis, the foodstuffs were subjected to acid digestion in a sealed septum vial and the headspace gas so generated was analyzed by gas chromatography with a Hall, or halogen specific, detector.

Semivolatiles and Pesticides in Animal Tissue

The semivolatiles and pesticides have been previously listed in Table D-3. For biota analyses, both compound classes were analyzed by the same extraction and analytical procedure. Measurement of the compounds in the concentrated extract was performed using GC/Hall detector or capillary column GC/MS.

Metals in Hair and Vegetation

Metals were analyzed in hair and vegetation samples after appropriate sample digestion/extraction. The metals of interest were the 14 elements previously listed in Table D-3. Analysis was performed by various AAS methods for hair samples and by AAS or ICP for vegetation.

CORRESPONDENCE CONCERNING QA PLANS

GCA

GCA CORPORATION
Technology Division
Burlington Road
Bedford, Massachusetts 01730
[illegible]
[illegible]

November 10, 1980

Ms. Patty Ragsdale
Compuchem/Mead Technology Laboratories
5 Triangle Drive
Research Triangle Park, NC 27709

Dear Patty:

The requested revisions to your QA Plan for your work on the Love Canal Study (GCA Subcontract 1-619-026-222-002E) have not yet been received. The "Quality Assurance Guidelines" document which you submitted is not acceptable without the cited project-specific material. All subcontractor QA Plans are submitted to EPA after GCA's review; yours is annotated to show that revisions have been requested and not received.

These revisions can be quite brief but should be project-specific and include:

- a brief description of your project work and your internal organization to accomplish it.
- internal QC procedures that meet or exceed the requirements specified in your subcontract document and in Appendix B of the Love Canal QA Plan.
- identification of your Project QA Coordinator and the individuals responsible for Document Control, sample custody, Internal QA/QC and Corrective Action.
- your procedures for documenting corrective action.

The suggested Subcontractor's QA Plan outline included in your subcontract covers these points and is intended to be helpful to you. Please consult it or me should you have any further questions. The project-specific information you provide will be sent to EPA after our review of it at GCA.

Sincerely,

RoseMary Ellersick

RoseMary Ellersick
QA Manager

RME/cf

cc: R.M. Bradway
K. McConnaghy K.T. McGregor ✓

BRANCH OFFICE 500 Eastowne Drive • Chapel Hill, NC 27514 • (919) 489-6550

GCA

GCA CORPORATION
Technology Division

213 Burlington Road
Bedford, Massachusetts 01730
Telephone: 617-275-5444
Telex: 92-3339

29 January 1981

Mr. Kevin McConnaghy
Compuchem/Mead Technology Laboratories
5 Triangle Drive
Research Triangle Park, NC 27709

Dear Kevin,

The revised QA Plan for Compuchem's work on the Love Canal Study (GCA Subcontract 1-619-026-222-002E) has been reviewed. With the understanding that internal QC requirements specified in GCA's subcontract analytical protocols have been followed even though they are not explicitly stated in your QA Plan, the plan is acceptable. It has been approved by the undersigned for GCA and submitted to EPA for final approval.

Thank you for following the suggested outline in your revision and for providing most of the requested project-specific information.

Sincerely,

RoseMary Ellersick
RoseMary Ellersick
QA Manager

Kenneth T McGregor
Kenneth T. McGregor
Technical Monitor

Robert M Bradway
Robert M. Bradway
Program Manager

RME/cf

cc: S. Bromberg, EPA
P. Ragsdale, Compuchem

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GCA
GCA CORPORATION
Technology Division
Burlington Road
Bedford, Massachusetts 01730
(617) 275-5444
Telex [illegible]

November 13, 1980

Dr. David Ben-Hur
PJB Laboratories
Jacobs Engineering Group, Inc.
251 South Lake Avenue
Pasadena, CA 91101

Dear Dr. Ben-Hur:

The QA Plan submitted for PJB's work on the Love Canal Study (GCA Subcontract 1-619-026-222-002F) has been reviewed and found to be deficient in several respects. These include:

- The QA Project Coordinator, Document Control Officer and Sample Custodian have not been identified.
- Document Control has not been addressed.
- Discrepancies exist between internal QC procedures as specified in GCA's analytical protocols and in Section 4.0 of your QA Plan.

On the condition that internal QC procedures listed in the appropriate sections of Appendix B to GCA's QA Plan be followed, your plan has been approved for GCA by the undersigned and submitted to EPA. Please provide a statement indicating your compliance with this condition, and identify the individuals responsible for QA, Document Control and sample custody.

Sincerely,

RoseMary Ellersick
RoseMary Ellersick
QA Manager

Kenneth T. McGregor
Technical Monitor

Robert M. Bradway
Robert M. Bradway
Program Manager

RME/cf

PJB LABORATORIES
ANALYTICAL CHEMICAL SERVICES

December 4, 1980

GCA/Technology Division
213 Burlington Road
Bedford, Massachusetts 01730

Attention: RoseMary Ellersick

Dear Ms. Ellersick:

Following are our responses to your letter concerning the QA Plan for the Love Canal Study (Subcontract 1-619-026-022-022F):

a. Quality Assurance and Document Control - Jane Freemyer
b. Sample Custody - Olga Kendall
c. Compliance with QC Procedures of Appendix B -

As much as possible our laboratory has complied with the QC Procedures. Several deviations, however, were necessitated due either to insufficient sample size of lack of availability of internal standards and surrogates. Specifically:

1. In the analysis of volatile organic compounds in soils and sediments the internal standard dichloromethane-d_4 and the surrogates 1,2-dichloroethane-d_4 and p-chlorotoluene-d_4 were not available and, therefore, not used.

2. The sample size for semivolatile organics was often too small to prepare duplicates. Clarification on the mode of splitting the sample to provide for duplicates was received after the samples had already been extracted. Therefore, the number of samples analyzed in duplicate is very limited. The same applies to samples received for pesticide analysis in water.

3. Water samples received for metal analysis were often insufficient to provide for duplicates and spikes, in the frequency required by the QC plan.

373 SOUTH FAIR OAKS AVENUE, PASADENA, CALIFORNIA 91105 • (213) 795-7553 681-4655

con't

Spikes were given preference by our laboratory; consequently the number of duplicate runs is limited.

I trust the above information would clarify your questions.

Sincerely,

David Ben Hur

David Ben-Hur, Ph.D.
Assistant Laboratory Director

fmc

cc: K.T. McGregor including Group 3 PE results

GCA

GCA CORPORATION
Technology Division
[illegible]
[illegible]
[illegible]
[illegible]

November 13, 1980

Dr. John Hosenfeld
Midwest Research Institute
425 Volker Boulevard
Kansas City, MO 64110

Dear Dr. Hosenfeld:

Your QA Plan for MRI's work on the Love Canal Study (GCA Subcontract 1-619-026-222-0021) has been reviewed and found to be acceptable as submitted.

The contract QC requirements contained in GCA's analytical protocols and presented in your subcontract and in Appendix B to GCA's QA Plan are not addressed in your QA Plan; it is understood that they must be followed. With this condition, your QA Plan has been approved for GCA by the undersigned and submitted to EPA for final approval.

Thank you for your cooperation in following the suggested QA Plan outline and providing the requested project-specific information.

Sincerely,

RoseMary Ellersick
RoseMary Ellersick
QA Manager

K T McGregor
Kenneth T. McGregor
Technical Monitor

Robert M. Bradway
Robert M. Bradway
Program Manager

RME/cf

cc: E. Conrad, MRI

EXAMPLES OF LABORATORY CONTROL CHARTS

LC 1-619-026-27-Q

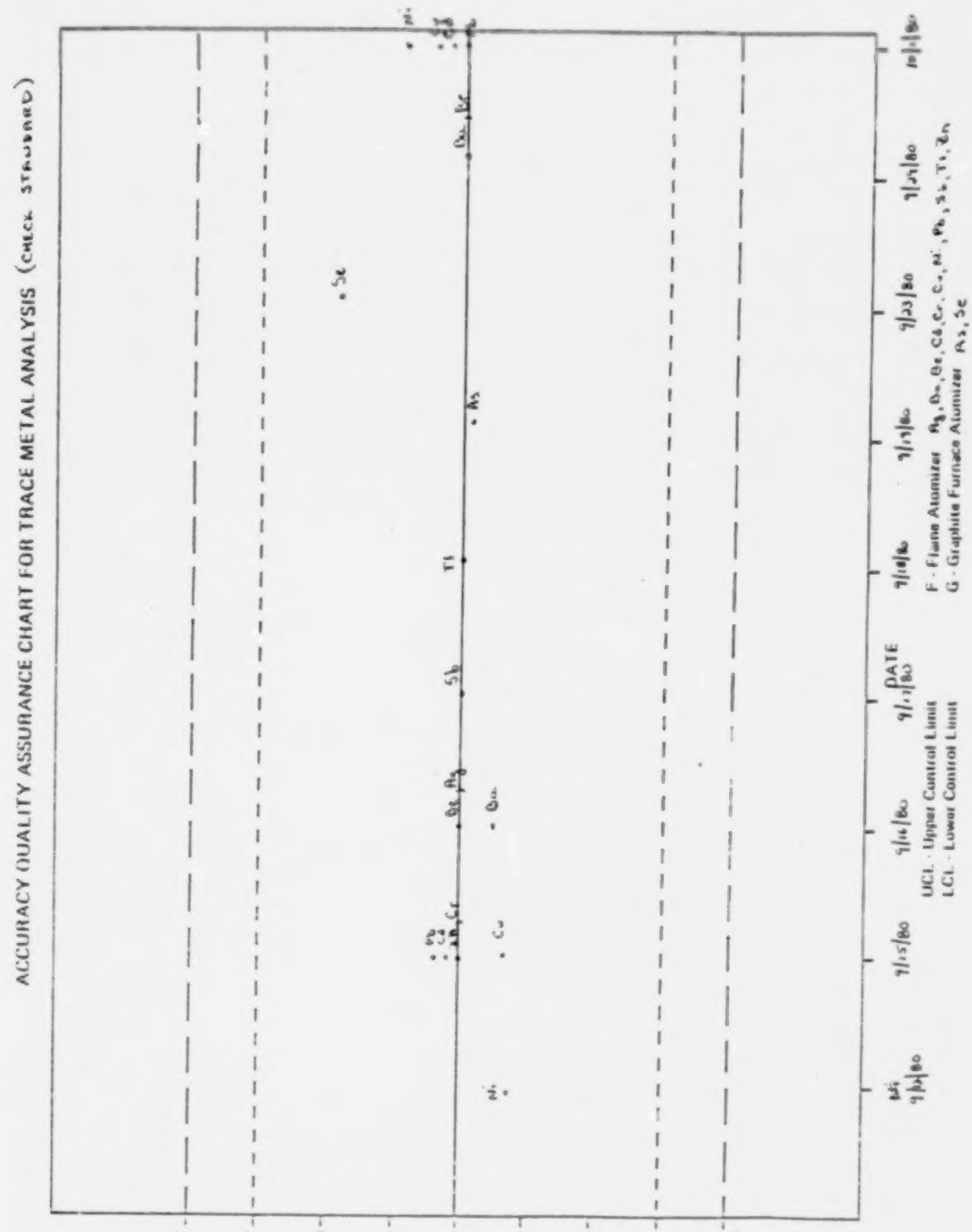


Figure 5. Quality Assurance Chart

ERCO Control Chart on LCS for Metals Analysis

LC 1-619-026-27-Q

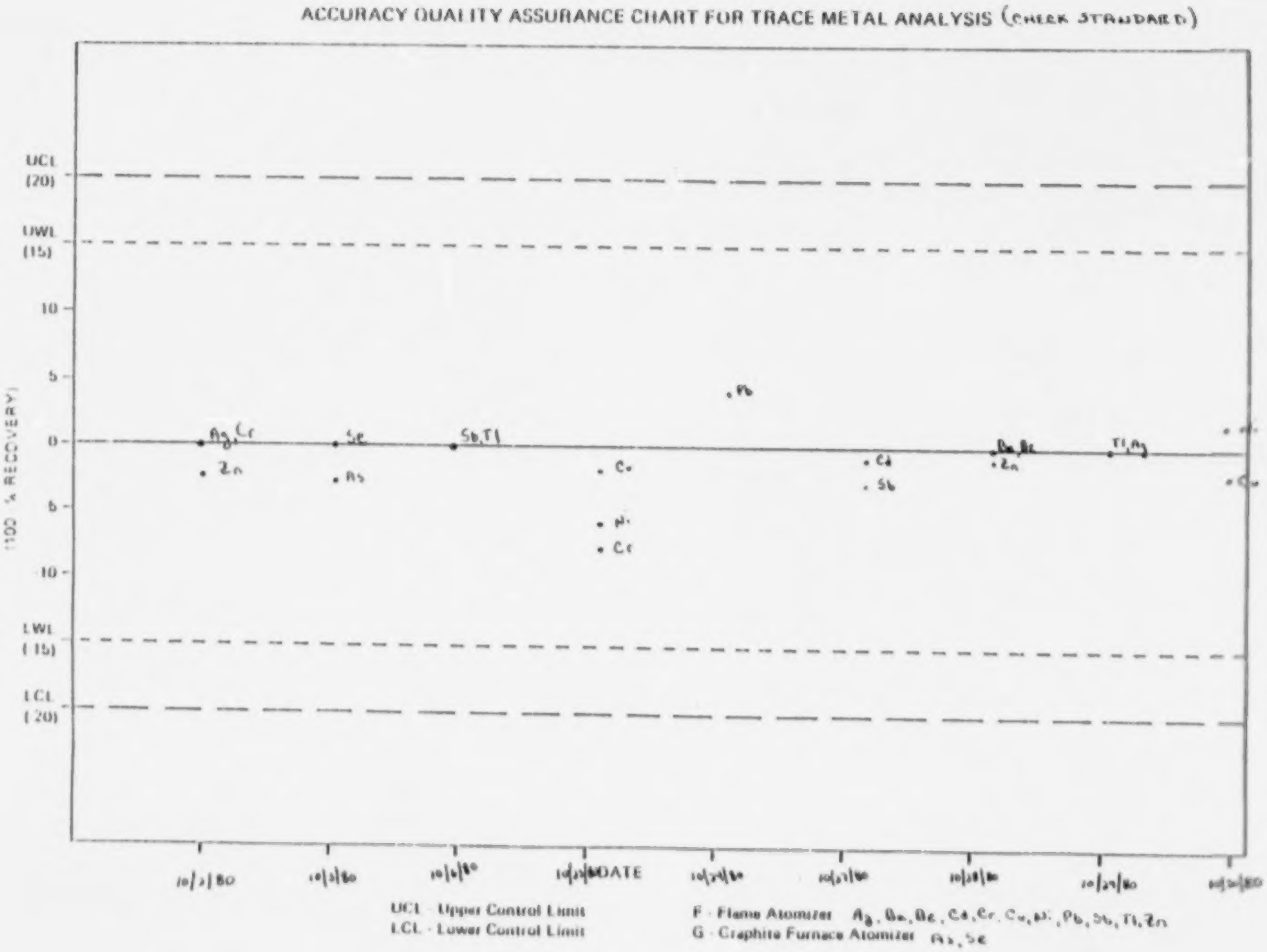


Figure 3. Quality Assurance Chart

ERCO Control Chart on LCS for Metals Analysis

LC 1-619-026-27-Q

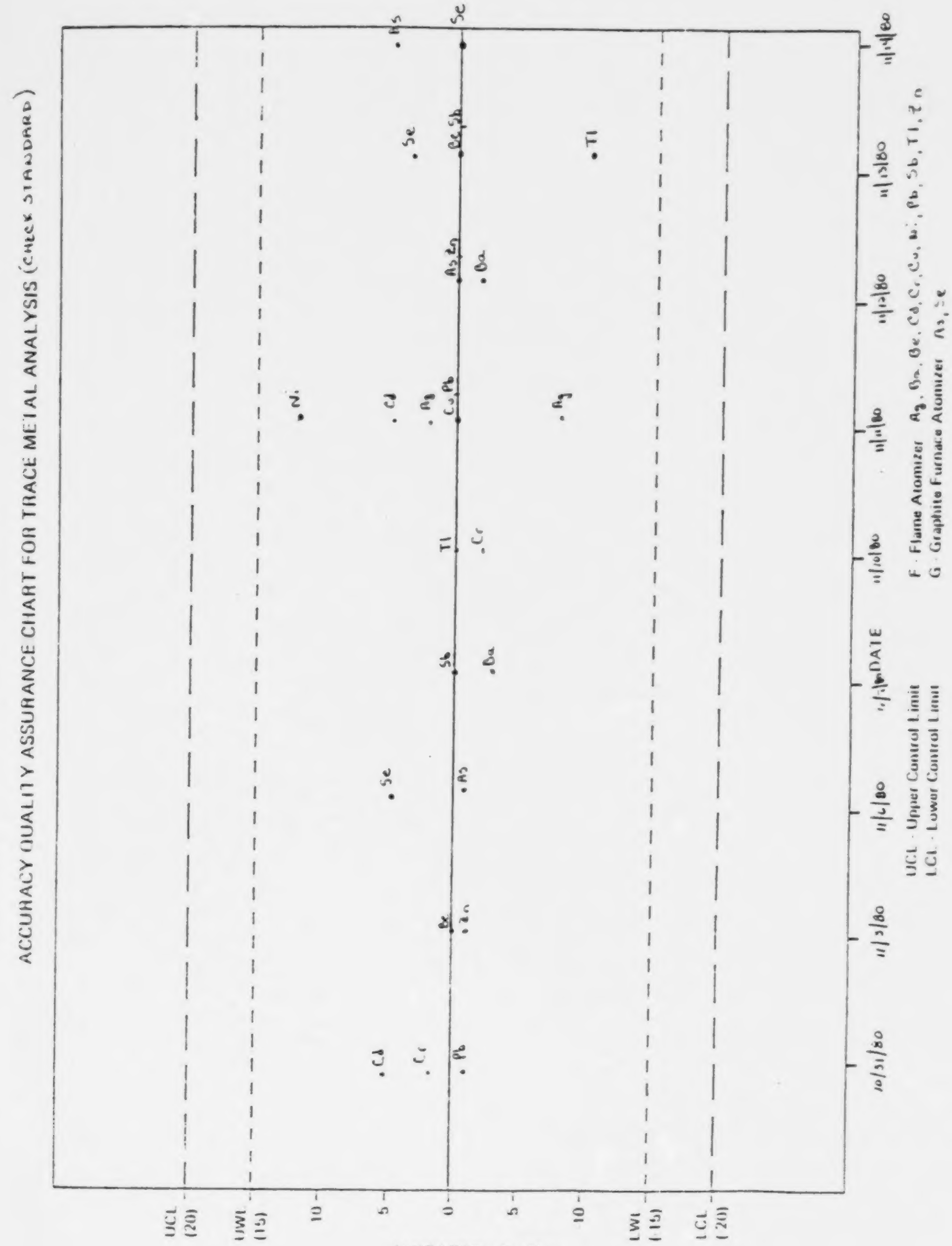


Figure 8. Quality Assurance Chart

ERCO Control Chart on LCS for Metals Analysis

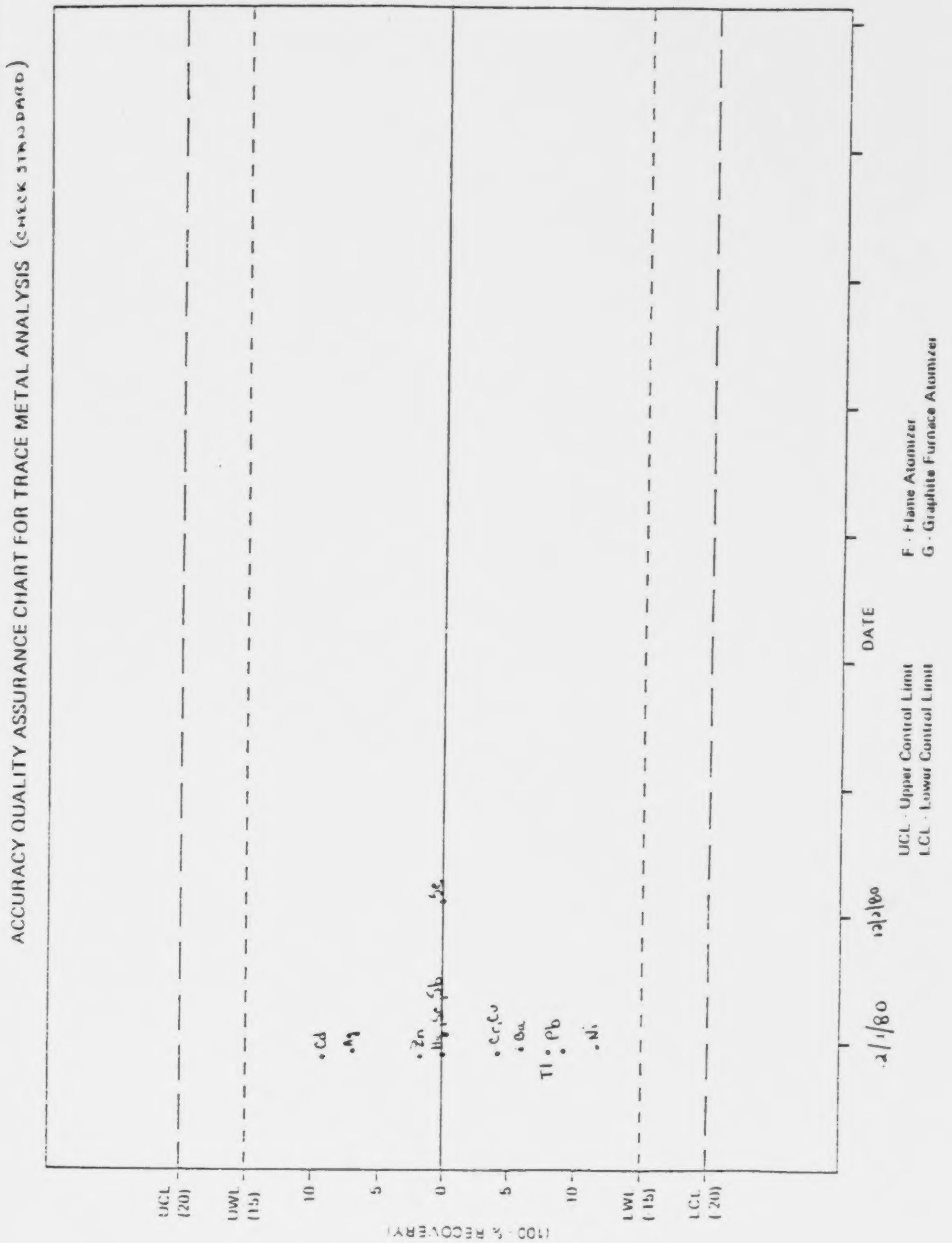
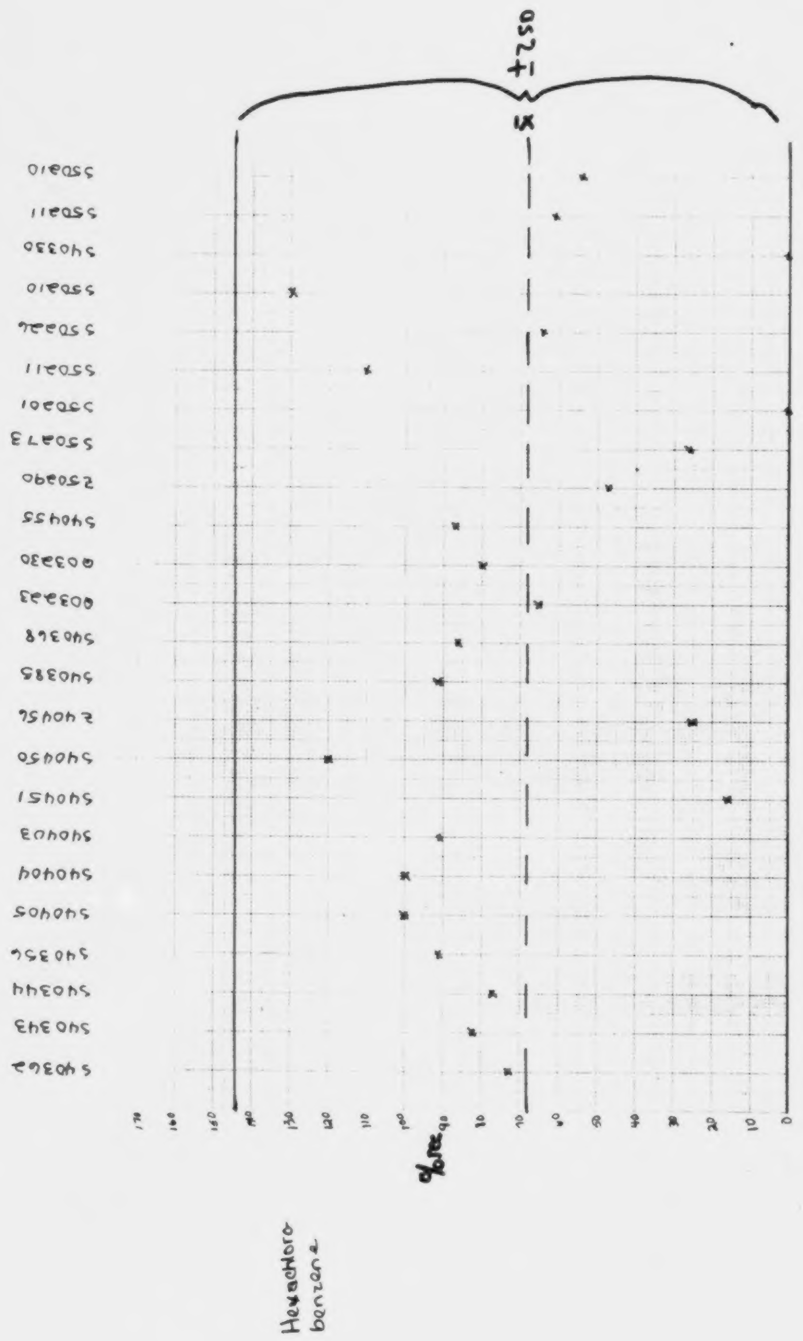
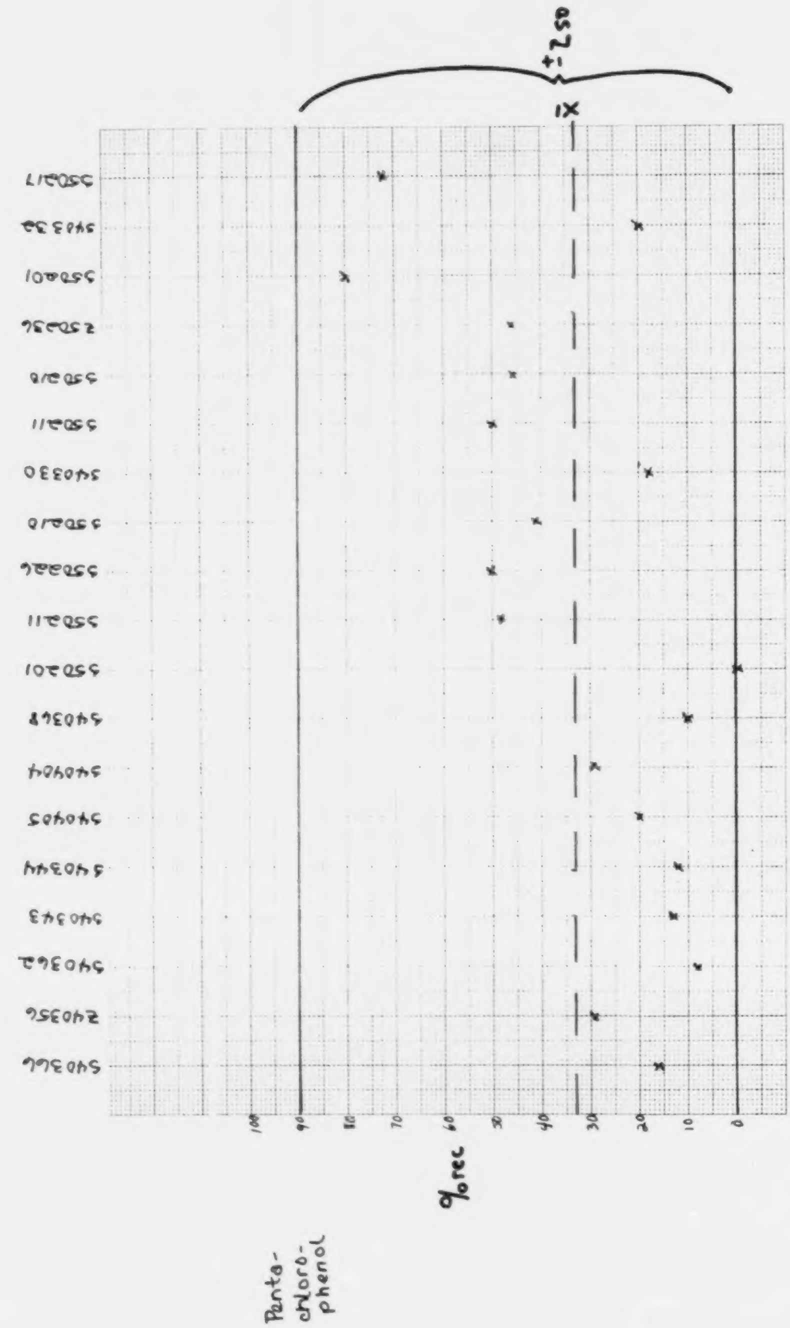


Figure 8. Quality Assurance Chart

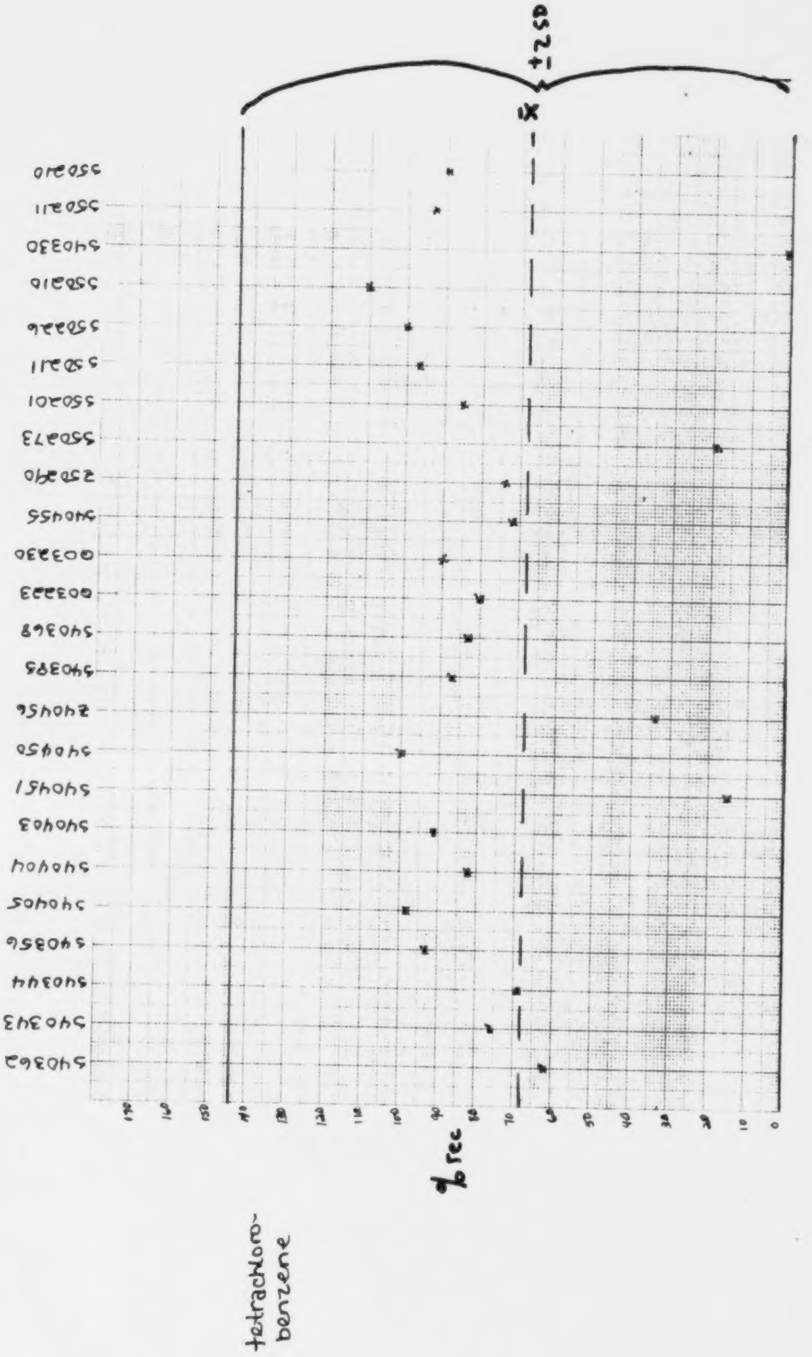
ERCO Control Chart on LCS for Metals Analysis



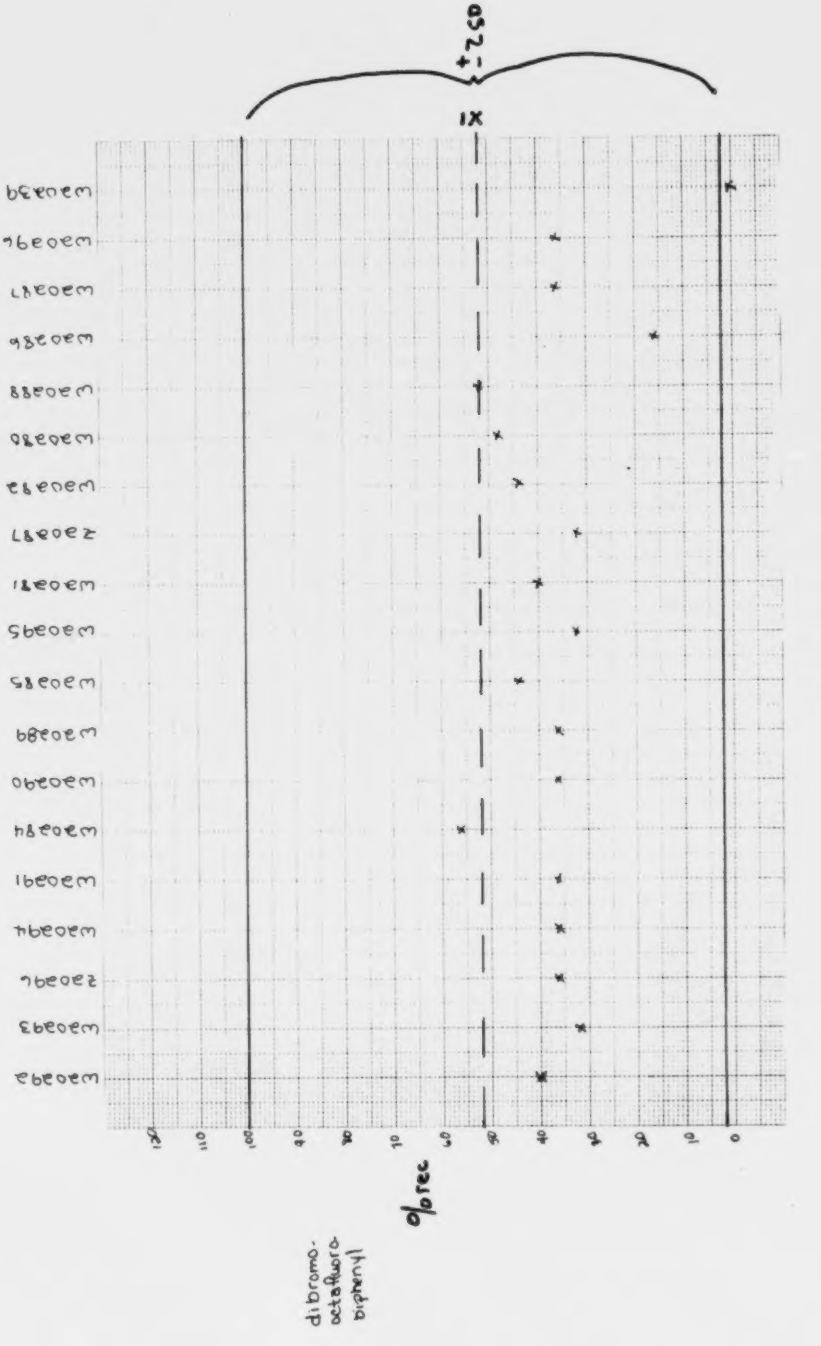
GSRI Control Chart on Surrogate Compound Recovery for Semivolatile Organics in Soils



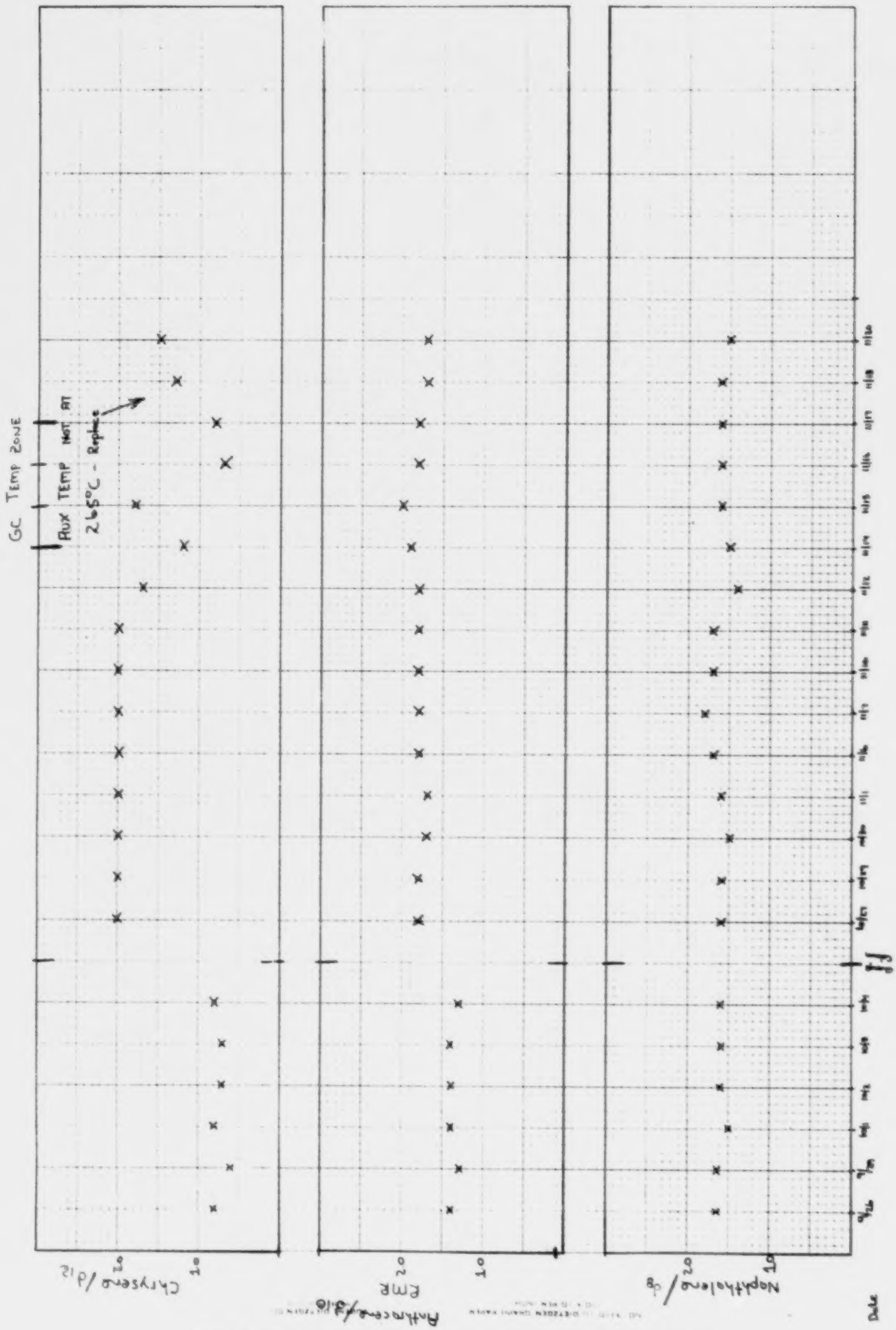
GSRI Control Chart on Surrogate Compound Recovery for Semivolatile Organics Analysis in Soils



GSRI Control Chart on Surrogate Compound Recovery for Semivolatile Organics Analysis in Soils



GSRI Control Charts on Surrogate Compound Recovery for Semivolatile Analysis in Water



GSRI Control Chart for Internal Standards
for Semivolatile Organics Analysis